



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :  G07B 17/00		A1	(11) International Publication Number: <b>WO 92/17861</b>
			(43) International Publication Date: 15 October 1992 (15.10.92)
(21) International Application Number: PCT/US92/02510		(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent).	
(22) International Filing Date: 1 April 1992 (01.04.92)			
(30) Priority data: 678,063 1 April 1991 (01.04.91) US			
(71) Applicant: PI ELECTRONICS INCORPORATED [US/US]; 9777 West Gulf Bank Road #5, Houston, TX 77040-3113 (US).			
(72) Inventors: GIL, Asher ; 5922 Pine Arbor, Houston, TX 77066 (US). DARON, John, B. ; 9006 Arbor Wood, Houston, TX 77040 (US).			
(74) Agent: TOEDT, D., C., III; Arnold, White & Durkee, P.O. Box 4433, Houston, TX 77210 (US).			
<p><b>Published</b>  <i>With international search report.</i> </p>			
<p><b>(54) Title:</b> AUTOMATED SELF-SERVICE PACKAGE SHIPPING MACHINE</p> <p><b>(57) Abstract</b></p> <p>A self-service apparatus (100) capable of automatically handling envelopes and packages through various stages of processing, including touch screen (110) to handle various inputs from the customer, digitized voice (112) to prompt the customer and instruct him in the processing, electronic weighing (138), electronic printing (142) of the ZIP+4 barcode, electronic printing of the shipping label (140), electronic printing of the receipt (128), electronic printing (140) of the manifest documentation for both the letters and packages, and maintaining of the manifest documentation for both the letters and packages. Mailing charges are deducted from a prepaid magnetic card through the use of a magnetic card reader (122). Maintaining postage and shipping rates, ZIP+4 CD-ROM directory in order to locate the ZIP+4 information. A dual floppy disk system (124, 126) to allow the mailer to send electronic mail. A built-in facsimile apparatus (120) to allow the customer to send "FAX" information through the telephone line.</p>			

**FOR THE PURPOSES OF INFORMATION ONLY**

**Codes used to identify States party to the PCI on the front pages of pamphlets publishing international applications under the PCI.**

AT	Austria	ES	Spain	MC	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	RU	Russian Federation
CG	Congo	KP	Democratic People's Republic of Korea	SD	Sudan
CH	Switzerland	KR	Republic of Korea	SE	Sweden
CI	Côte d'Ivoire	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
DE	Germany	MC	Monaco	TG	Togo
DK	Denmark			US	United States of America

## 10 AUTOMATED SELF-SERVICE PACKAGE SHIPPING MACHINE

15 The invention relates to automated self-service systems for receiving and initially processing letters and other packages for subsequent transportation by the U.S. Postal Service and/or private package shipment companies.

20 The Appendix sets forth copyrighted subject matter. No objection is made to reproduction of the Appendix solely in connection with reproducing any patent that may issue from this application, but all other rights under 25 copyright law are reserved.

30 An automated self-service machine in accordance with the invention advantageously combines features of mailroom automation systems with features of bank automated teller machines. The machine may be located in post offices, convenience stores, and the like.

35 A notable aspect of the self-service machine is its user interaction. In operation, the machine conducts a dialog with a user/customer, via a touch screen and a digitized voice output (or other input/output devices), to obtain information about the customer's intended shipment address, class of service, and the like. The customer may specify, e.g., first-class mail, registered

or certified mail, and the like. The customer may specify a language (e.g., English, Spanish) in which he or she wishes to communicate. Certain dialog segments are color-enhanced, e.g., a green representation of a 5 certified mail "green card" receipt is displayed on a color monitor to aid the customer in providing information about a certified mail letter.

The machine measures the weight and other dimensions 10 of the customer's package; the measurement is performed automatically for packages whose dimensions fall within specified limits. Using these measurements and the customer-provided information, the machine computes the postage or other shipping charge. The shipping charge 15 may include a fee charged by the owner of the convenience store or other machine location, e.g., to cover the overhead cost of having the machine on-site.

The machine obtains payment from the customer, 20 notably through the use of a prepaid, low-cost charge card which may be sold in convenient denominations at the machine's location (e.g., at a convenience store). A magnetic card reader for handling such cards may be connected through a conventional interface directly to, 25 e.g., a convenience store cash register. Alternatively, the customer may use a [REDACTED]

The machine prints a routing/shipping label for the 30 customer's package. If the package is a simple first-class letter, the label may comprise a postal bar code printed directly on the letter's envelope. The bar code may embody the nine-digit ZIP+4 code of the destination address, which may be looked up by the machine from a database in a CD-ROM disk. If the package 35 is a letter to be sent by certified mail, the machine prompts the user to insert a U.S. Postal Service

-3-

certified mail "green card" blank form for printing. If the package is a box or large envelope, the machine may print a shipping or mailing label, including an appropriate routing/tracking bar code, on peel-off label stock; the customer may then apply the label to the package.

5 Prior to printing a shipping label or bar code, the machine may advantageously consult a directory (e.g., a ZIP+4 directory) to verify that the destination ~~address~~

10 ~~is specific and correct, and contains the right envelope by tracking number.~~  
Furthermore, the information obtained from the customer by the machine includes the customer's name, address, and telephone number, enabling the shipping company to 15 contact the customer more readily if the customer's package cannot be delivered.

When the customer's transaction is complete, the 20 labeled package is automatically received into a locked storage compartment in the machine. The storage compartment may be emptied at a convenient time, e.g., by a convenience store clerk, and its contents delivered to the U.S. Postal Service or other shipping company. A 25 sensor detects when the storage compartment is full and alerts appropriate personnel.

A printer in the machine prints a customer receipt. The printer may be a thermal printer, and the receipt may be printed on aluminized stock, to reduce the chance of 30 customer alteration of the receipt.

When a machine operator (e.g., a convenience store clerk) inputs an appropriate instruction at the "end of the day," a hard-copy manifest of packages received by 35 the machine is generated.

The machine may be operated by a customer in an "Inquiry" mode. For example, a customer may use the machine simply to look up the nine-digit ZIP code for a particular street address. This feature may be provided 5 free of charge as a courtesy.

Like reference numerals are used to refer to the same components and parts in all of the following Figures:

10

Figure 1 is a perspective view of an automated mailing apparatus in accordance with the present invention;

15

Figure 2 is a top view of the letter-handling system assembly of the apparatus of Figure 1;

20

Figure 3 is a top view of the apparatus of Figure 1;

Figure 4 is a front view of the apparatus of Figure 1 showing portions of a package tilting mechanism;

25

Figure 5 is a side view of the apparatus of Figure 1 showing portions of the package tilting mechanism with the package scale in the upright position;

30

Figure 6 is a side view of the apparatus of Figure 1 showing portions of the package tilting mechanism with the package scale in a tilted position;

35

Figure 7 is a side view of the apparatus of Figure 1 showing portions of a printer tilting mechanism;

35

Figure 8 is a side view of the apparatus of Figure 1 showing portions of the printer tilting mechanism when the printer is rotated to a fully upright position;

Figure 9 is a top view of the apparatus of Figure 1 showing portions of the printer tilting mechanism;

5 Figure 10 is a top view of the apparatus of Figure 1 showing portions of the printer tilting mechanism of Figure 9;

10 Figure 11 is a front view of a portion of the apparatus of Figure 1 showing the package acceptance door sliding mechanism;

15 Figures 12a, 12b, and 12c collectively comprise a block diagram of computer hardware in the apparatus of Figure 1;

20 Figure 13 is a diagram of the main electronics board of the apparatus of Figure 1;

25 Figures 14a, 14b, and 14c collectively comprise a schematic diagram of the control signal circuitry of Figures 12a, 12b, and 12c;

30 Figure 15 is a schematic diagram of the multiple-printer card 1258 from Figure 12c;

35 Figure 16 is an illustration of a silk-screen mask for PC board 1302 of Figure 13;

40 Figure 17 is a schematic diagram of the voltage-to-frequency weigh card 1202 from Figure 12a;

45 Figures 18a and 18b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class regular letter;

Figures 19a and 19b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class letter in "Sav-A-Day" mode;

5 Figures 20a and 20b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class, certified letter;

10 Figures 21a and 21b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class, registered letter;

15 Figures 22a and 22b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a first class, insured letter;

20 Figures 23a and 23b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in responding to a customer inquiry regarding first class mailing;

25 Figures 24a and 24b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in mailing a package;

30 Figures 25a and 25b collectively comprise a flow diagram illustrating operation of the apparatus of Figure 1 in responding to a customer inquiry regarding mailing of packages;

35 Figure 26 is a flow diagram illustrating operation of the apparatus of Figure 1 in printing packages and letters manif st;

35 Figure 27 is a data flow diagram for the control system of the apparatus of Figure 1;

-7-

Figure 28 is a data flow diagram for the first class mail subsystem of the apparatus of Figure 1;

5 Figure 29 is a data flow diagram for the report generation subsystem of the apparatus of Figure 1;

Figure 30 is a data flow diagram for the package handling subsystem of the apparatus of Figure 1;

10 Figure 31 is a data flow diagram for the machine control subsystem of the apparatus of Figure 1.

Referring to Figure 1, a self-service package shipping machine 100 according to the invention is shown. 15 A letter-handling subsystem is shown on the right side of the machine, and a package-handling subsystem is shown on the left side. In the Figures, reference numerals are used to indicate components and parts as indicated below:

20 100 Zipster Plus ZP-3D Automated Mailing Apparatus  
102 sheet-metal housing  
104 letter acceptance slot  
106 package acceptance window  
108 package acceptance window door  
25 110 touch-screen computer monitor, Carroll Touch Company, Austin, Texas  
112 loudspeaker  
114 work tray  
116 ruler disposed on front of work tray 114  
30 118 divided compartments disposed in work tray 114 for containing work supplies and preprinted USPS forms, Federal Express/UPS forms, and the like  
120 fax machine  
35 122 magnetic card reader, COPYVENDOR cardreader by McKey Inc., of Harleysville PA -

124 3-1/2 inch floppy disk drive  
126 5-1/4 inch floppy disk drive  
128 thermal receipt printer  
130 dotted line denoting general area in which  
5 electronics are disposed  
132 dotted line denoting general area in which  
letter-handling system assembly is  
disposed  
134 letter tray  
10 136 dotted line denoting general area in which  
mechanism for sliding window door 108 is  
disposed  
138 (dotted line denoting) tilting package scale  
140 shipping and mail manifest printer  
15 142 package label printer  
144 package door  
146 letter door  
200 letter-handling system assembly disposed in  
20 area denoted by dotted line 132 in Figure  
1  
202 PC board assembly for left-justification and  
width measurement of letters  
203 electro-optical sensors for left-justification  
and width measurement  
25 204 stepping motor, model Superior MH112 by  
Superior Electric Company, Bristol CT  
206 gate mechanism letter stops  
208 base plate  
30 210 linear motion guide rail (THK SR301)  
212 letter clamp/Ledex solenoid  
214 guide rail support blocks  
216 idler assembly  
218 Hewlett-Packard ink-jet printer  
35 220 ink-jet printer pivot plate  
221 ink-jet printer pivot plate hinge

222 micro-switch for detecting when ink-jet printer  
218 has rotated into fully upright  
position

5 223 scanner (e.g., DEST Personal Scan B5N-21SCA  
scanning unit scanner with B5N-21FED page  
feeder)

224 Ledex solenoid for retracting gate mechanism  
letter stops 206

10 226 PC board assembly for letter justification and  
length measurement

227 electro-optical sensors for letter  
justification and length measurement

228 letter scale

230 load cell for letter weighing, e.g.,  
15 Transducers Incorporated, Cerritos CA,  
model no. 662A-D3-10-10P1

400 load cell for package weighing

402 trap door

20 404 linkage for simultaneous opening of trap door  
402 and tilting of package scale 138

406 tilting hinge

408 linear actuator for providing mechanical force  
to tilt scale 138 and trap door 402, model  
25 42846A by Dayton Corporation of Chicago

410 package storage compartment

600 package being tilted off of scale 138

602 packages stored in storage compartment after  
30 being tilted off of scale 138

700 linear actuator for providing mechanical force  
to rotate ink-jet printer 218, model  
42846A by Dayton Corporation of Chicago

35 702 linkage

704 linkage

-10-

706 pivot point between linear actuator 700 and linkage 702

708 pivot point between linkage 702 and linkage 704

710 pivot point between linkage 702 and housing 102

5

900 dotted line indicating portion of Figure 9 which is shown in greater detail in Figure 10

10 1100 metal guides to prevent inward movement of door 108

1102 stepper motor

1104 Kevlar timing belt

1106 THK linear rail

15 1108 Honeywell opto-electronic limit switch

1110 THK bearing for movement along guide rail 1106

1112 idler for engaging other end of timing belt 1104

20 1200 PC bus

1201 main 80386-based computer

1202 voltage-to-frequency weigh card

1204 scanner interface card (e.g., DEST Corp.)

1206 Hitachi interface card

25 1208 Hitachi CDR-3500 CD ROM drive

1210 IDE hard disk/floppy disk

1212 IDE 40-mByte hard disk drive

1214 Scientific Solutions stepper motor card (Cybernetic Microsystems Inc., San

30 Gregorio CA model no. CY-525A)

1216 Superior Motor Block 6180 -- PT Translator

1218 Superior Motor Block 6180 -- PT Translator

1220 input port

1222 input port

35 1224 input port

1226 safety micro-switch



-12-

Some features of the machine 100 are particularly noteworthy. As shown in Figure 2, the ink jet printer is tilted downward when at rest (the normal position of the HP printer), and rotated up as needed to print upward.

5 This is done by using an electrical linear actuator 700 and rotation linkages as shown in the Figure.

Packages are weighed by using a 100 lb load cell (strain gauge bridge). When a package is accepted, the

10 package platform 138 is tilted by an electrical linear actuator 408 to tip the package into the storage compartment area \_\_\_\_.

The package window mechanism is secured in the up position by a Ledex size 6ep solenoid. Once the solenoid is activated, the lock is released and the Superior stepping motor MH-LLR-PF-8020 begins to rotate. The motion is transferred into linear motion up and down by using a Kevlar timing belt. The THK bearing and the

15 idler pulley to home the window into its position. We are using optical sensor limit switches by Honeywell. The package window mechanism is mounted on the inner side of the package door.

25 The machine 100 of the illustrative embodiment is operated by computer software shown in detail in the Appendix, which comprises 265 pages each numbered in the lower right corner with serial numbers PI00001 through PI00265. As shown in the Appendix, a series of screen displays is presented to a user/customer on the touch screen 110; the customer's responses on the touch screen 110 or other input device (e.g., a conventional computer keyboard) are used in controlling the machine's operations.

5        The software controlling the machine also includes a ZIP+4 database and lookup software. In the illustrative embodiment, the ZIP+4 database and control software distributed by the First Data Resource Company of Memphis, Tennessee is used.

10      The interrelationship of the various parts of the machine 100 may be conveniently described through a discussion of the operation of the machine.

15      10      A user/customer starts the machine by inserting a prepaid charge card into the receiving slot of a magnetic card reader 122, which activates the apparatus. The charge card may be a conventional stiff-paper card with a magnetic stripe on one side, similar to those used by the Bay Area Rapid Transit system (BART) in the San Francisco area.

20      20      The customer then touches the touch screen 110, which may be a conventional touch screen activated by an infrared array or sonic waves or resistance screen. Touching the screen activates a voice system which instructs the operator through a loudspeaker 112 what the next step will be. By following the voice instruction and the printed instructions on the screen 110, the customer is led step by step through the processing of a package or a letter.

30      30      As shown by the illustrative screen displays in the Appendix and by the flow diagrams in Figures \_\_, once the customer has selected a First Class letter he follows the instructions. The customer then puts the letter into the letter acceptance slot 104. The letter handling system 200 moves the letter automatically through weighing, measuring, scanning and printing and finally depositing

-14-

the letter into the removable letter tray where all processed letters are collected.

Once a letter is processed, a receipt is printed for  
5 any letter that is certified, registered and insured. The cost of mailing is deducted from the prepaid magnetic card and the card is returned to the customer.

10 The customer is able to request an electronic mail operation (e.g., using a conventional electronic mail service such as MCI Mail) using one of the two types of floppy-disk drives 124, 126 by inserting a floppy disk into the drive and following the voice/touch screen 110 instruction. The customer is thereby able to transmit  
15 his files to another computer. The cost of the electronic mailing is deducted from the prepaid magnetic card and the card is returned to the customer.

20 The customer is able to request to use the built-in FAX scanner 120 in order to transmit documents across telephone lines to another location. The customer follows the voice and screen instruction and then inserts  
25 his documents one by one into the FAX scanner 120. The machine 100 automatically transmits the documents to the other location. The cost of mailing is deducted from the prepaid magnetic card and the card is returned to the customer.

30 The customer may select after inserting his prepaid magnetic card to process packages by touching the screen 110 and following the voice instructions. The package window door 106 opens, the customer puts the package inside the window on the package/scale/tilt assembly 400. The scale weighs the package; this weight is transmitted  
35 to the computer which calculates the charges according to the destination zipcode. Once all the information that

relates to the shipper and destination is entered by the customer using the touch screen 110, a shipping label is printed using a package label printer 142. The customer pastes the label to the package and touches the screen on the appropriate box as shown by the illustrative screen displays in the Appendix. Once the customer has finished the processing, the package window door 108 is automatically closed. A receipt is produced by the receipt printer 128. The cost of shipping the package is deducted from the prepaid magnetic card and the card is returned to the customer.

To detect customer attempts to cheat (e.g., by submitting a light package for weighing but actually depositing a heavier package for shipping), the package is reweighed just prior to acceptance. If more than a +1% variation is detected, an error message is generated and the package is not accepted.

To reduce the chance of a too-heavy weight measurement (e.g., because the customer inadvertently has his finger on the scale), the scale detects weight variations of 0.01 oz. The weight is not measured for shipping-charge computation purposes until the weight stabilizes.

The tare (zero weight) of the scale is monitored to verify that nothing is left on the scale and that the scale is not damaged.

It will be appreciated that the foregoing embodiment is described for purposes of illustration and not as a limitation on the exclusive rights of the inventors. Various changes may be made (e.g., through the substitution of components; implementation of software functions in hardware and vice versa; and the like).

-16-

without departing from the spirit of the invention. The embodiments which are claimed as the exclusive property of the inventors are as described in the claims below.

**CLAIMS:**

1. An automated self-service package shipping machine comprising:

5

(a) means for receiving a package;

10 (b) screen-display means for displaying user instructions;

10

(c) user input means for transmitting user preferences;

15

(d) means for printing a destination label;

(e) means for printing a customer receipt; and

(f) locking means for securing the package.

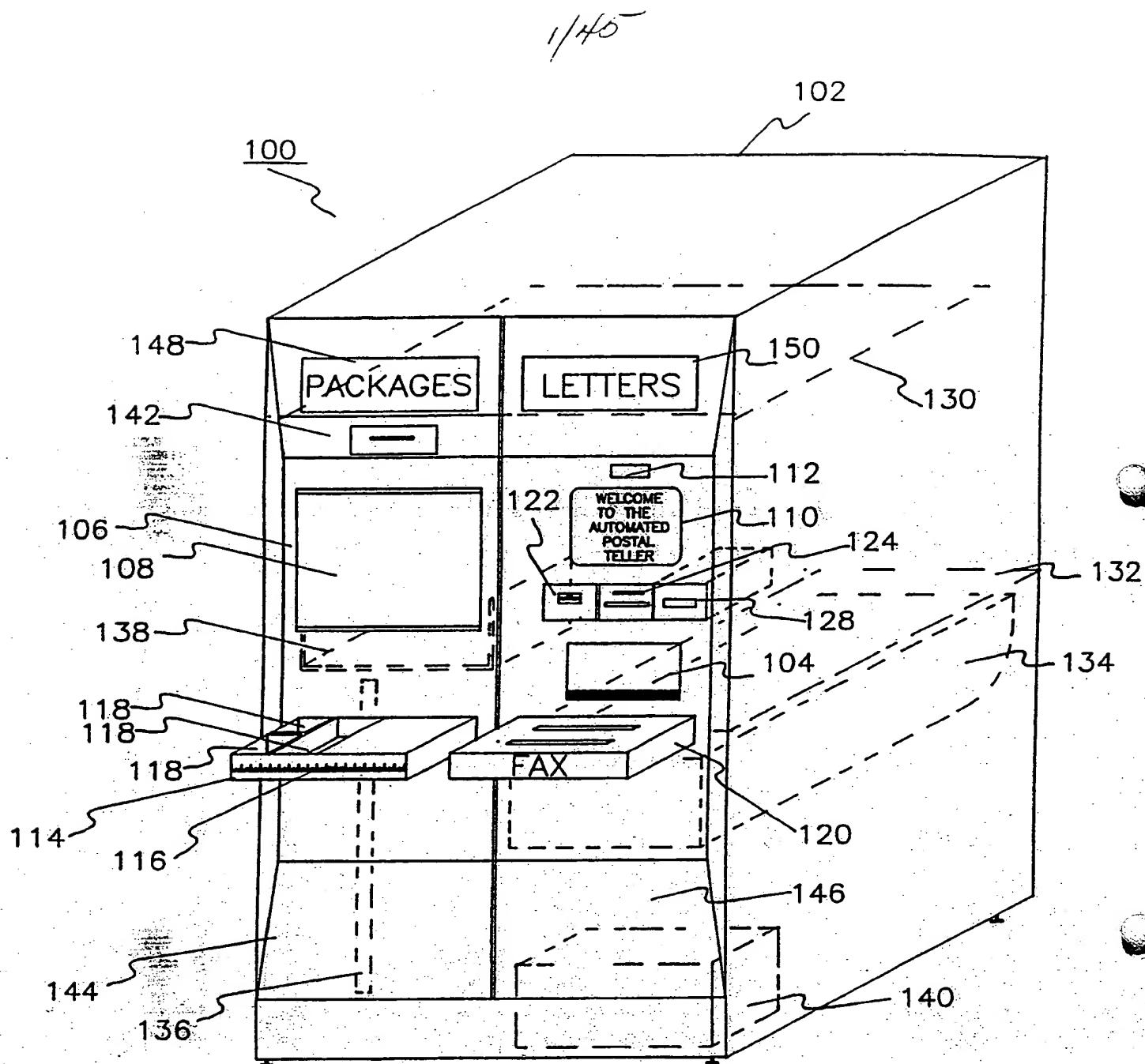


Figure 1

2/45

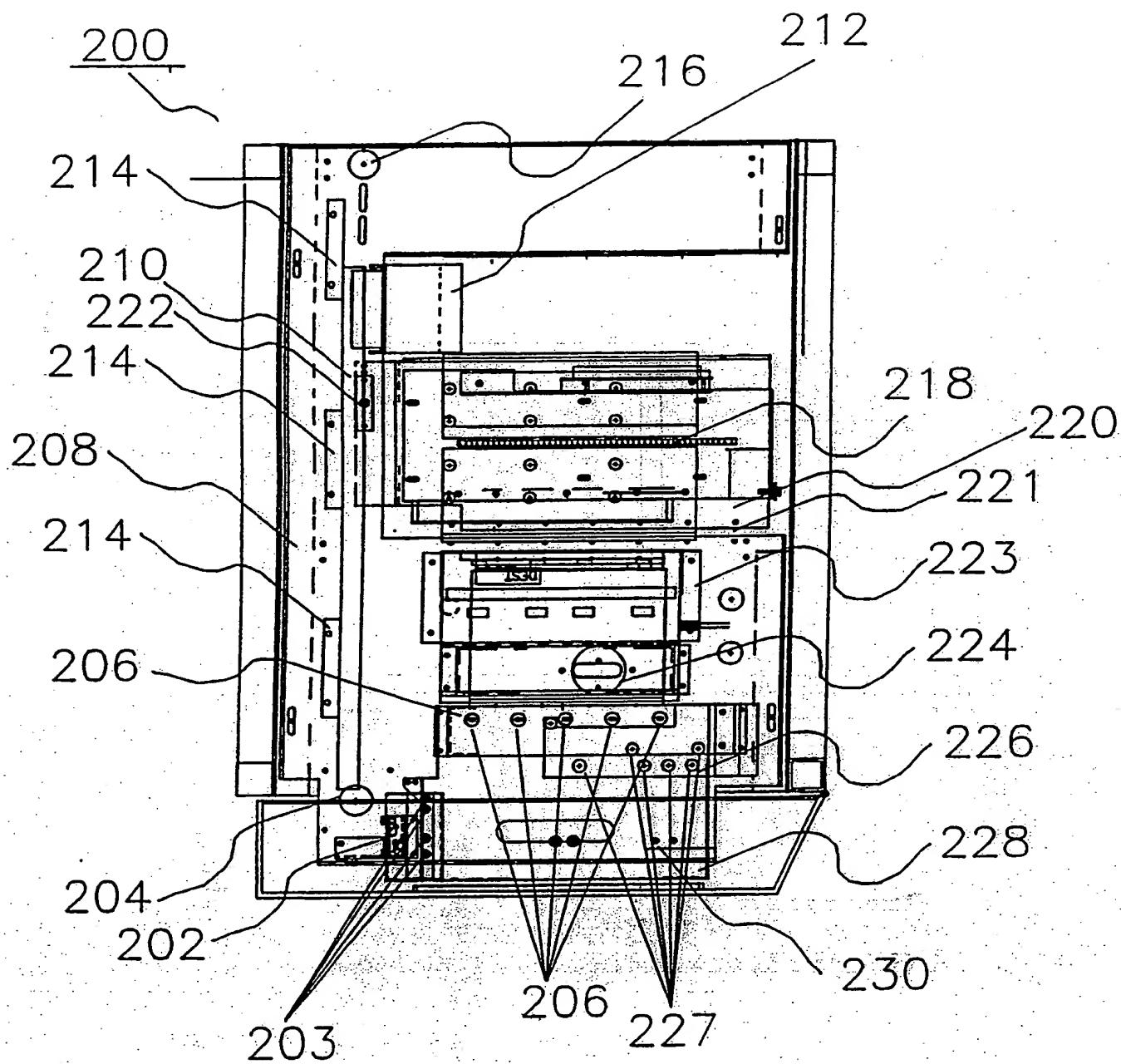
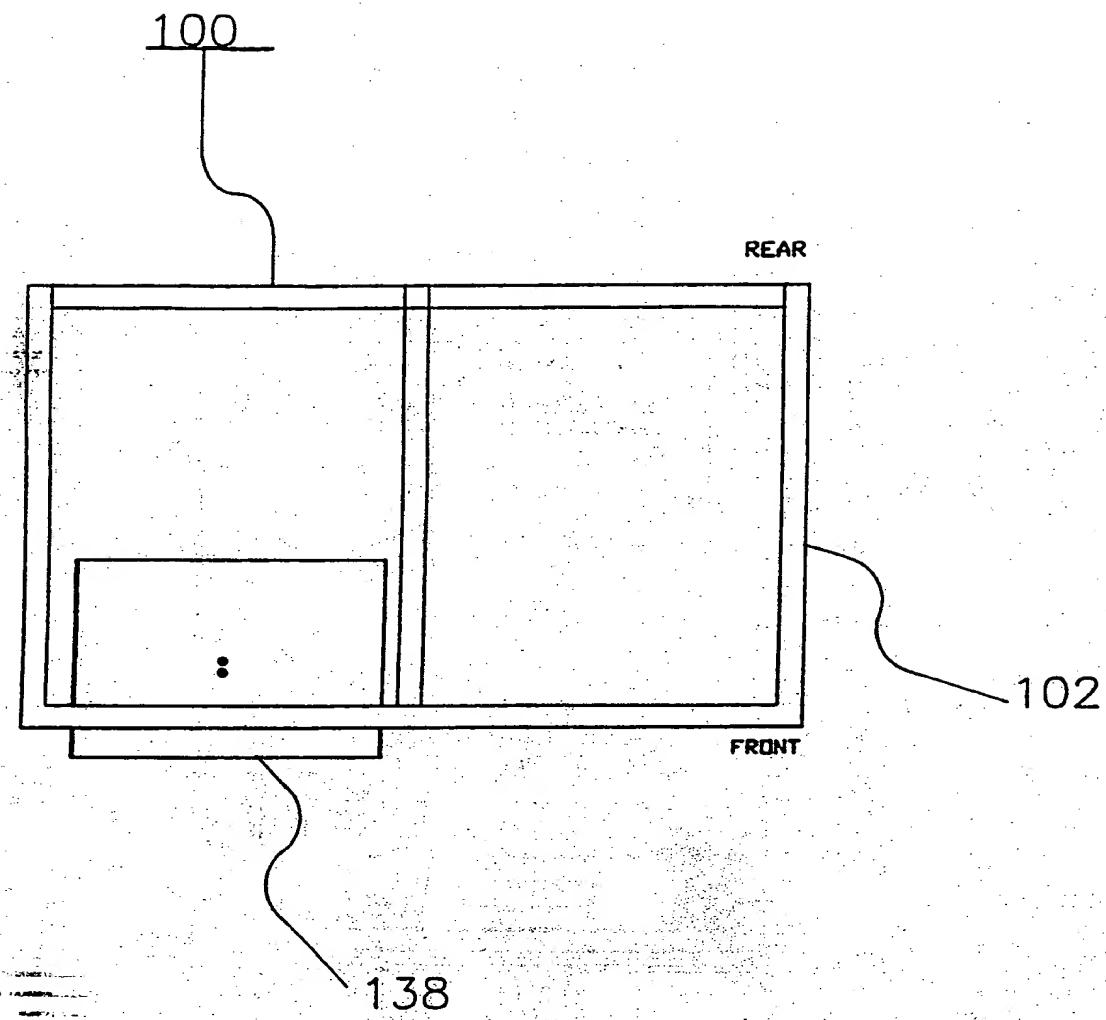


Figure 2

3/45



# Figure 3

4/45

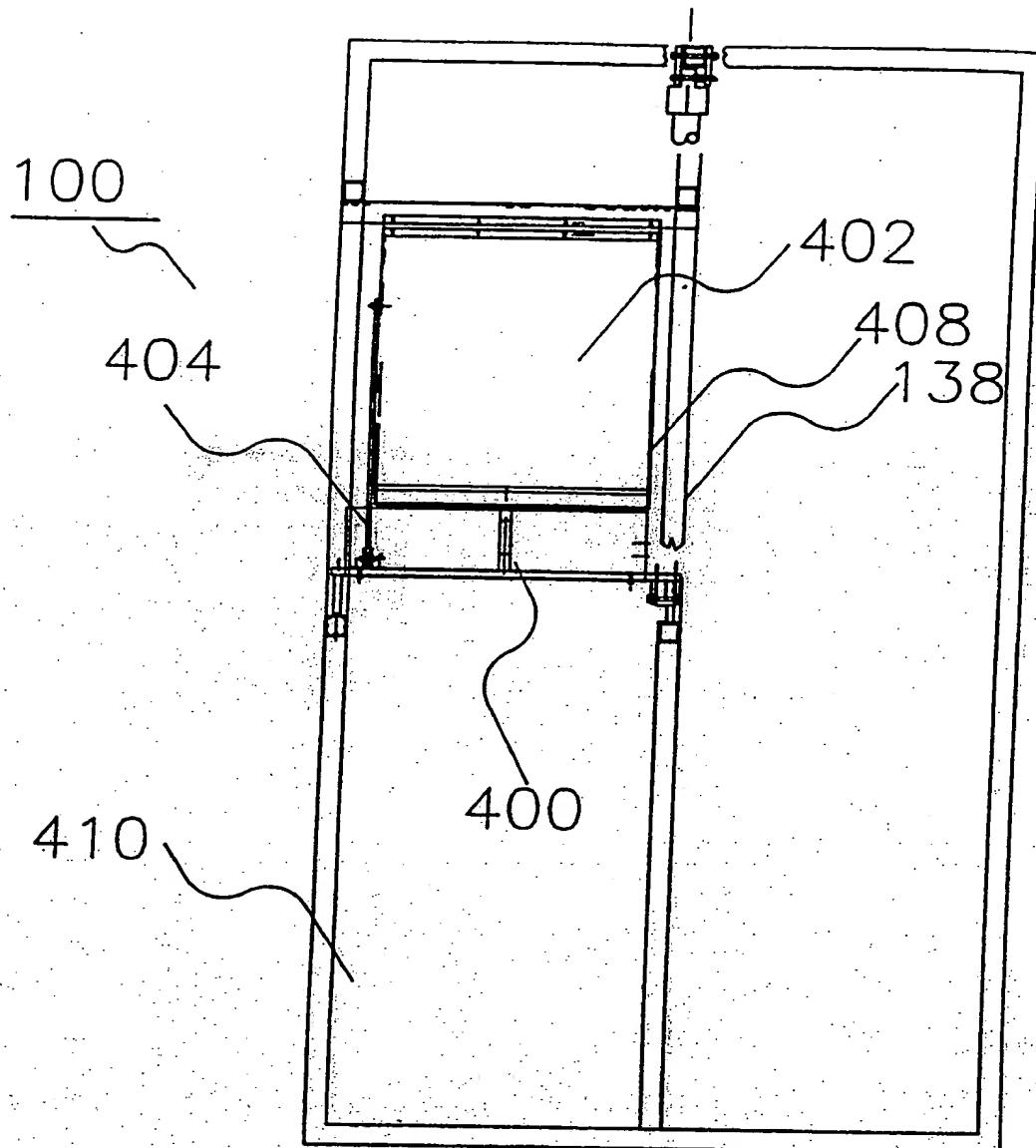


Figure 4

5/45

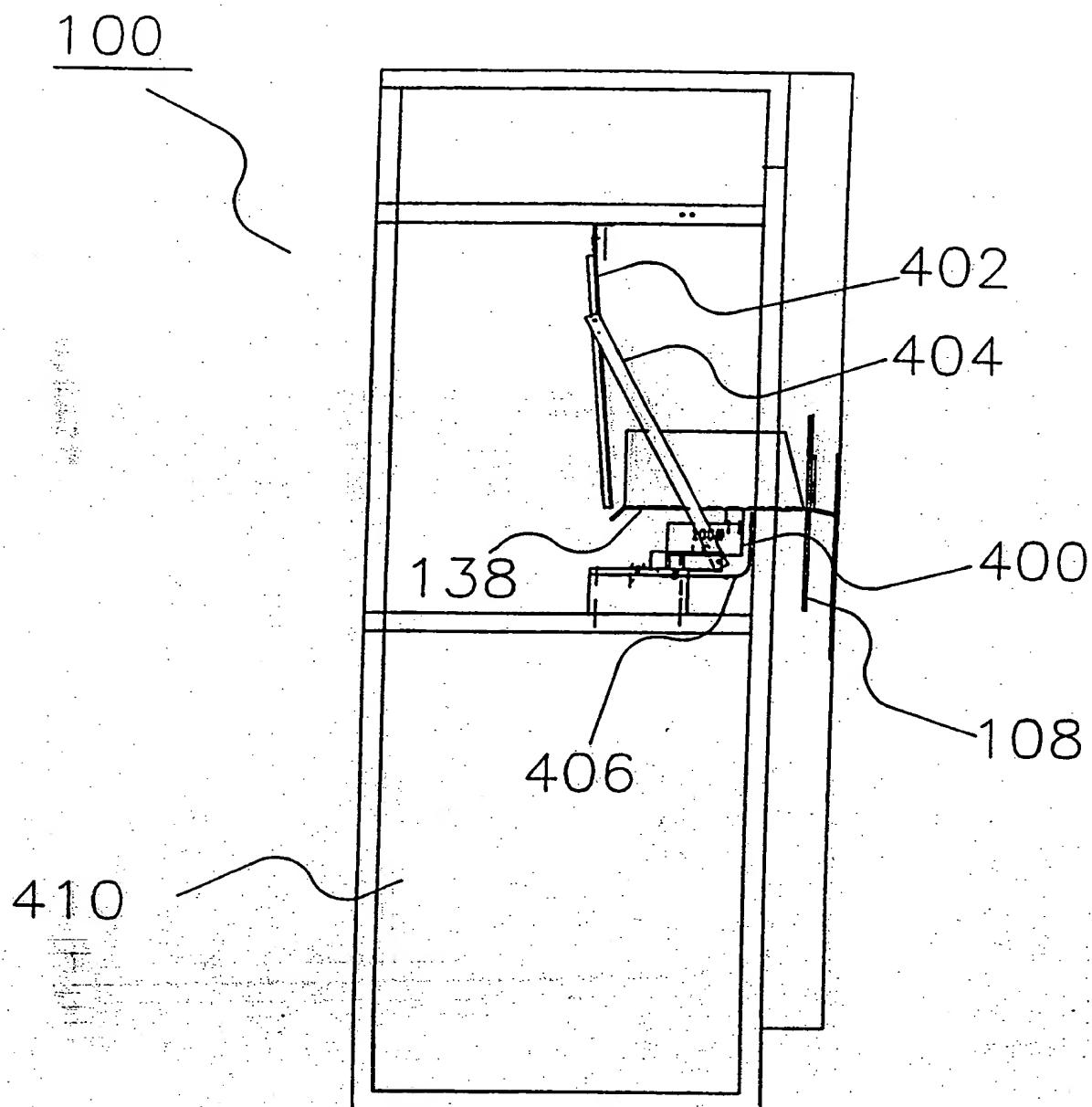


Figure 5

6/45

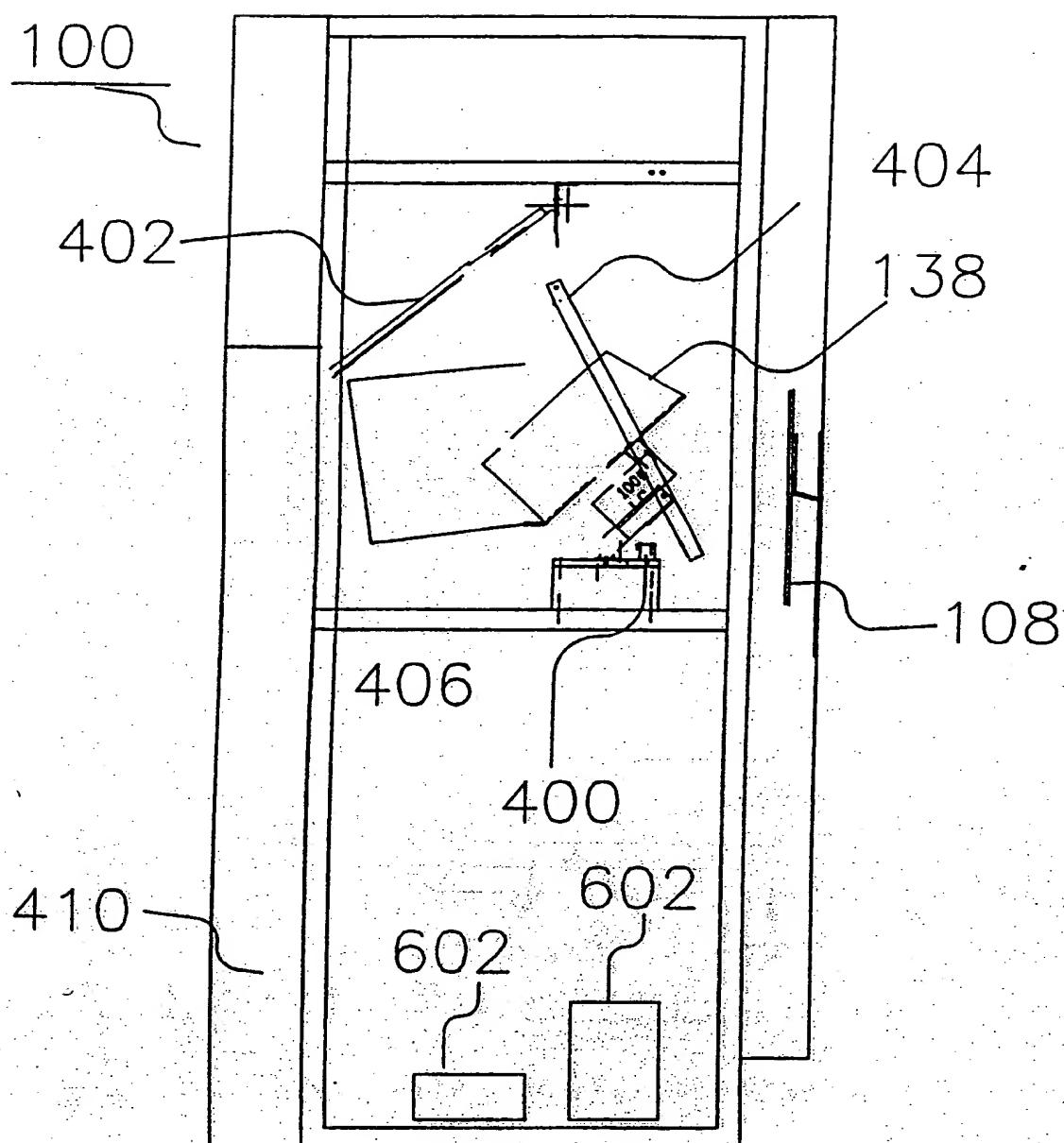


Figure 6

7/45

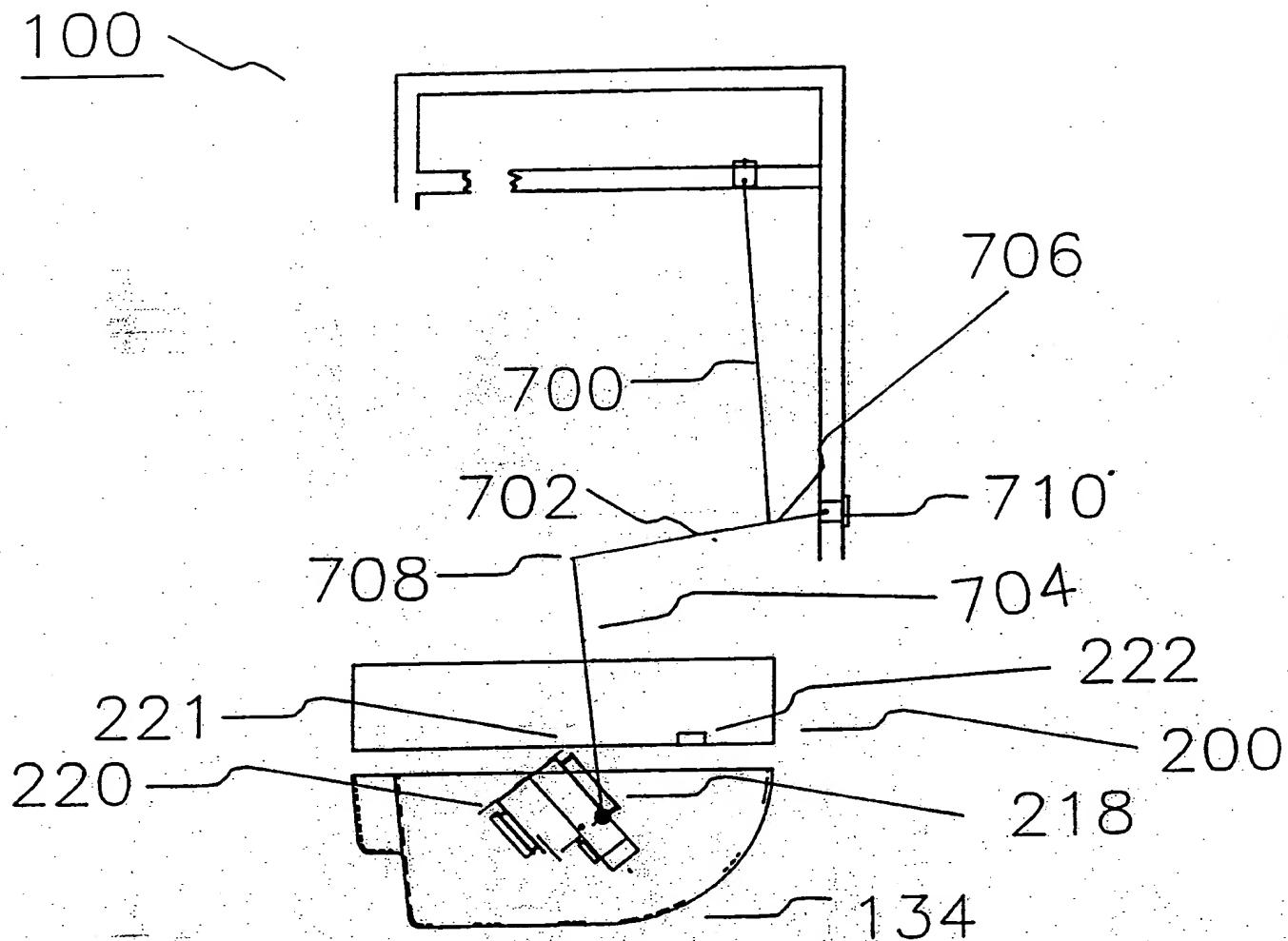


Figure 7

8/45

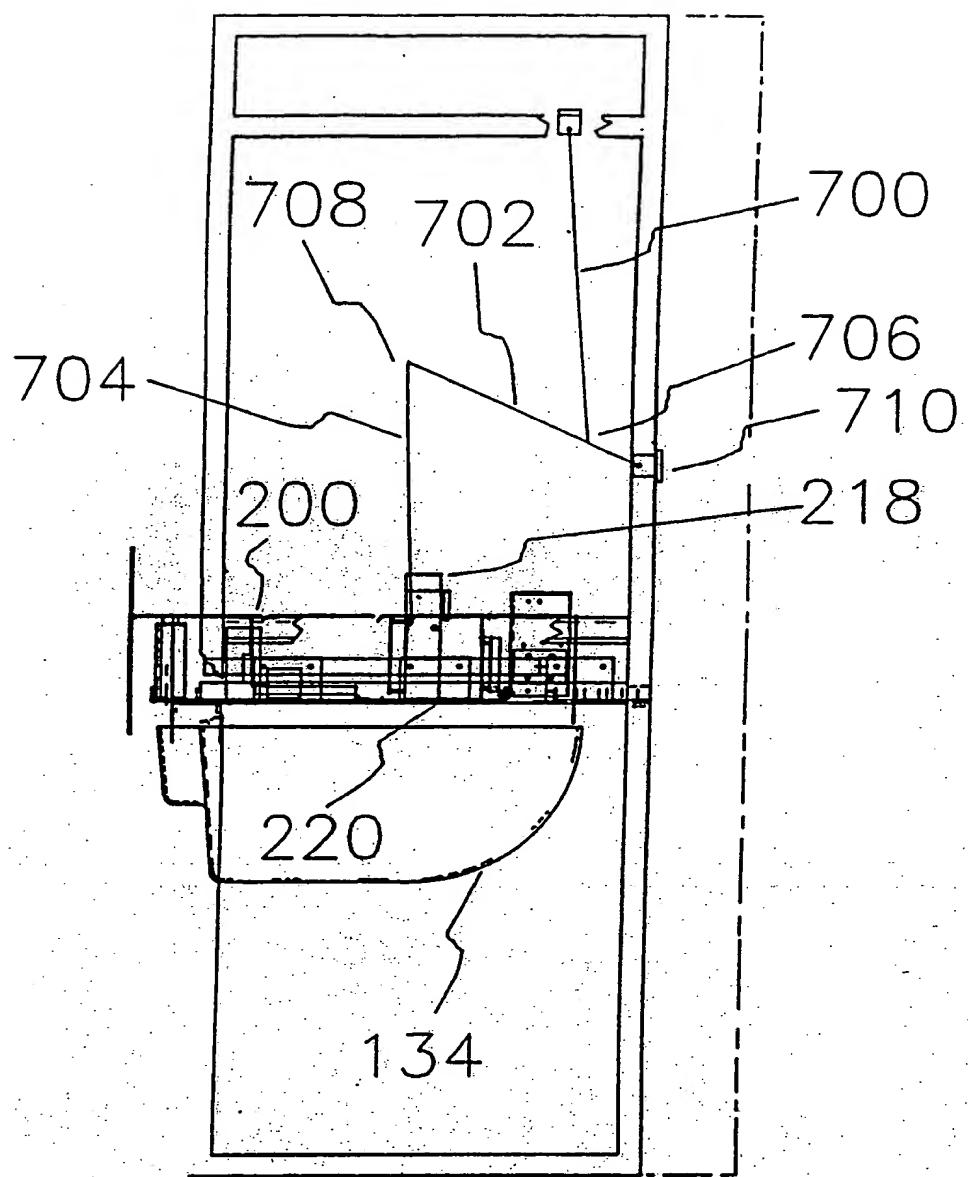


Figure 8

9/45

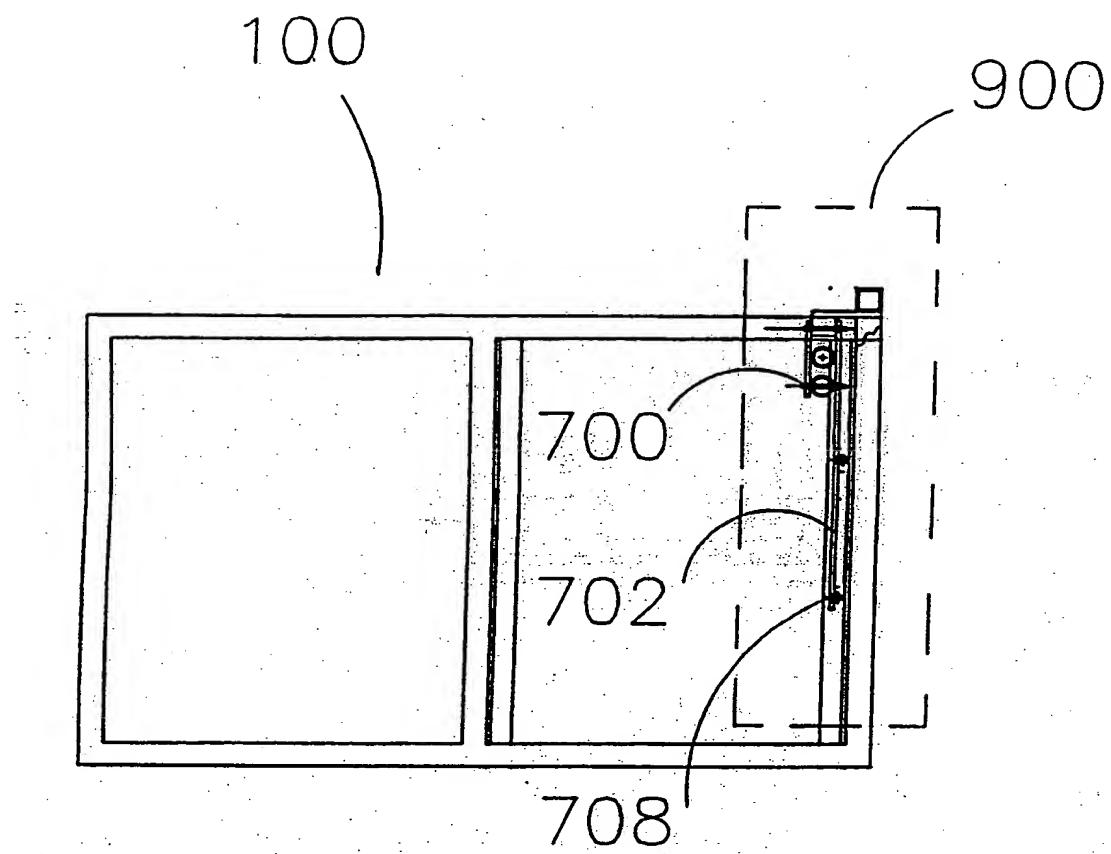


Figure 9

10/40-

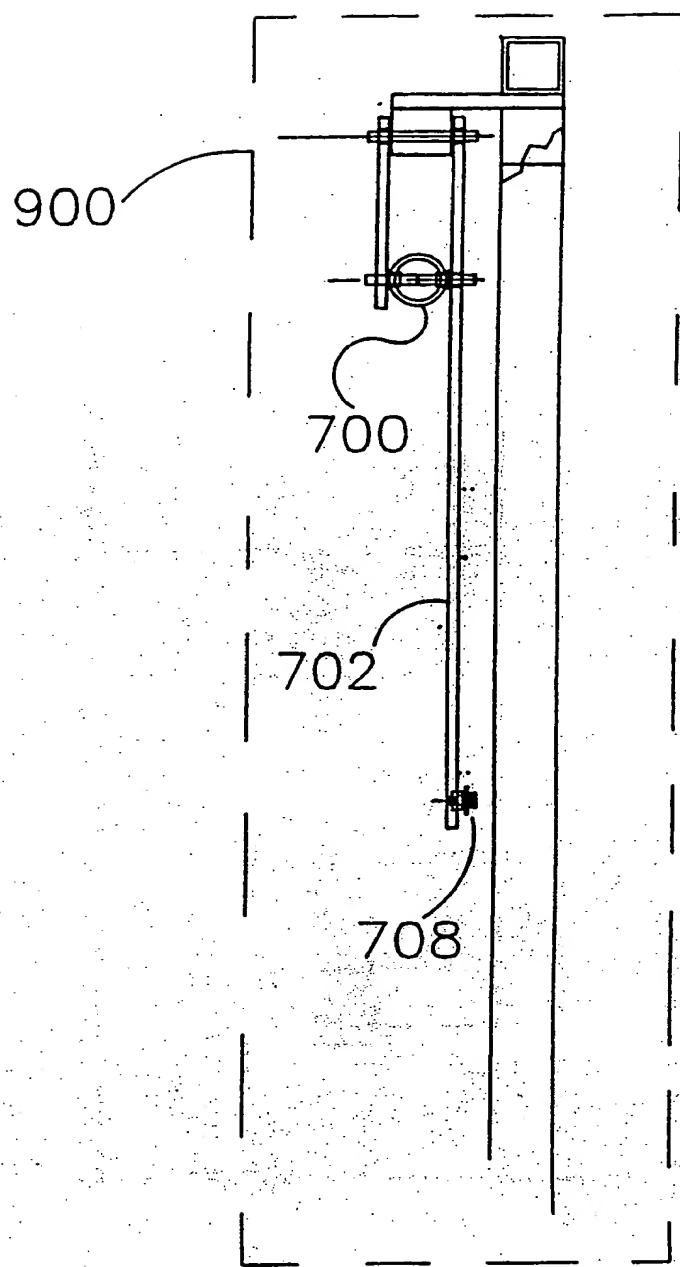


Figure 10

11/45

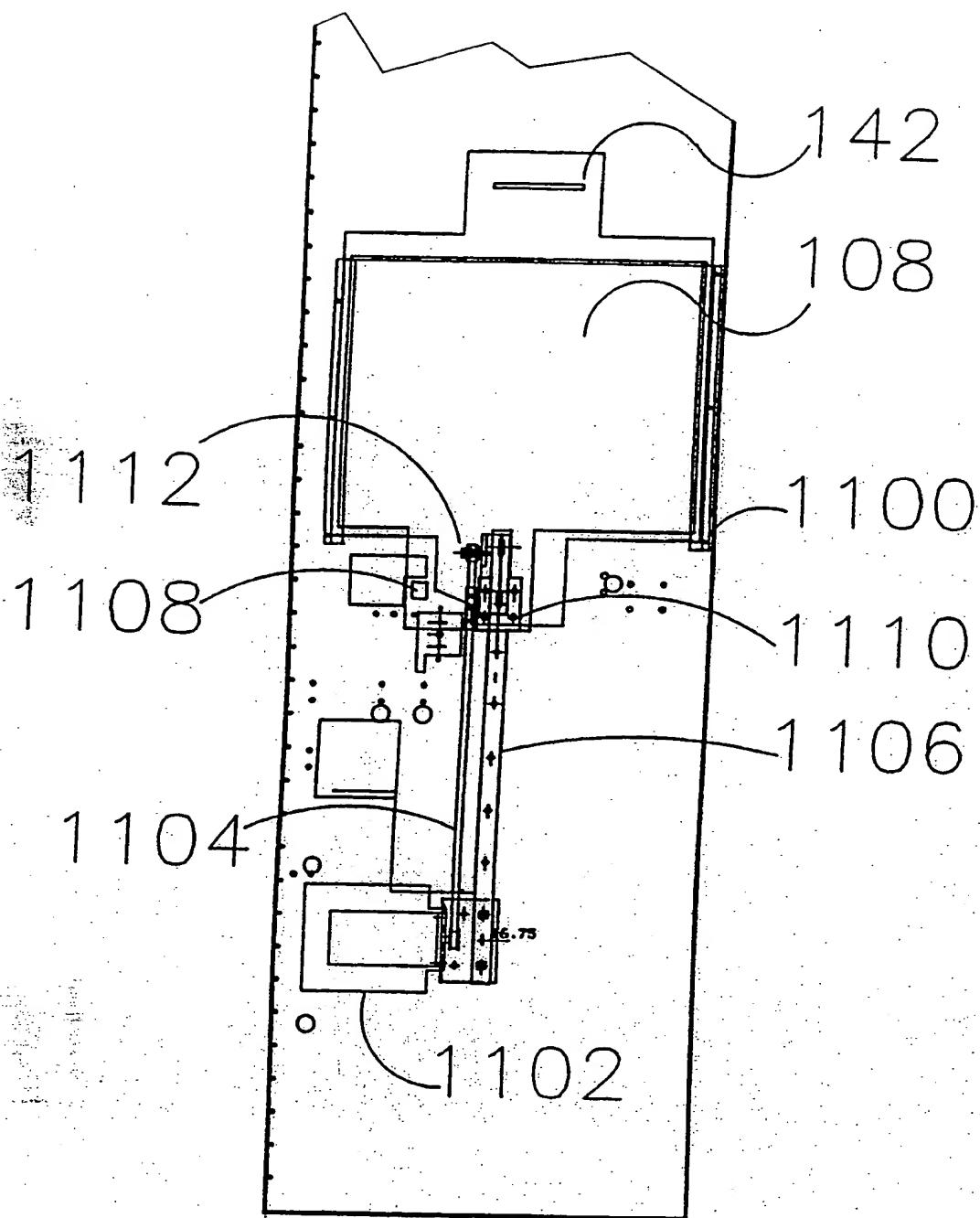
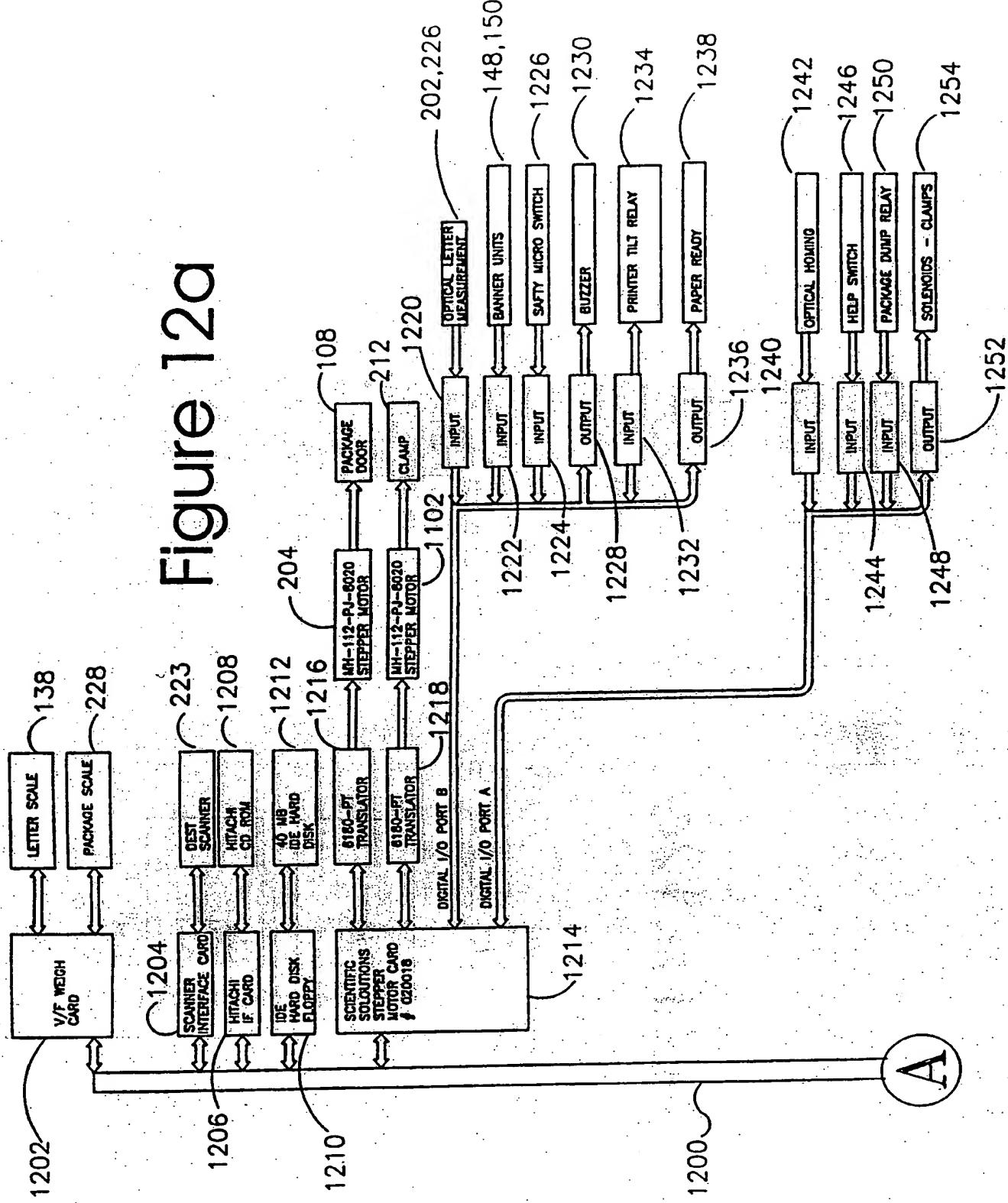


Figure 11

102/45

Figure 12a



13/45

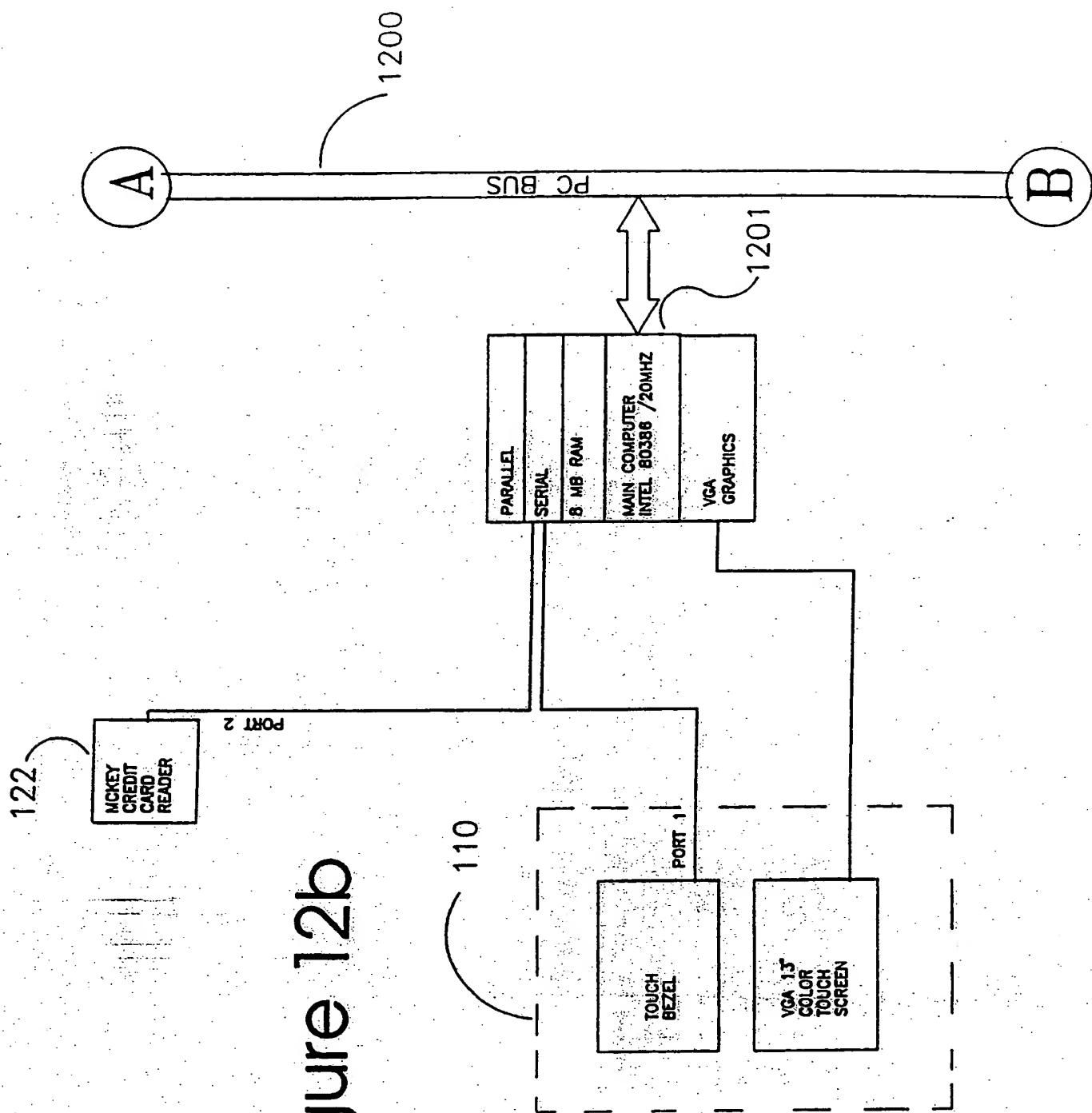
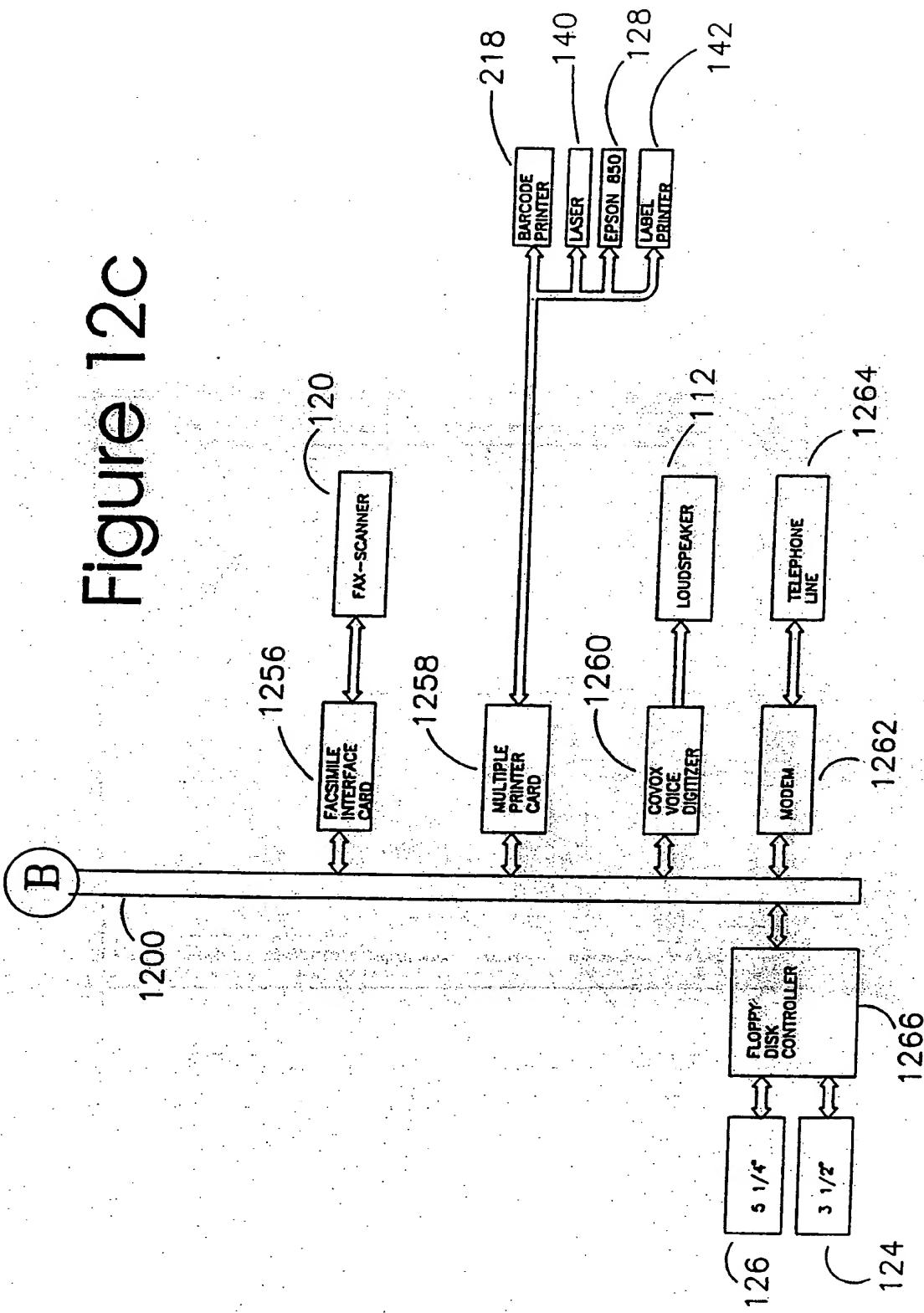


Figure 12b

14/45

Figure 12C



15/45

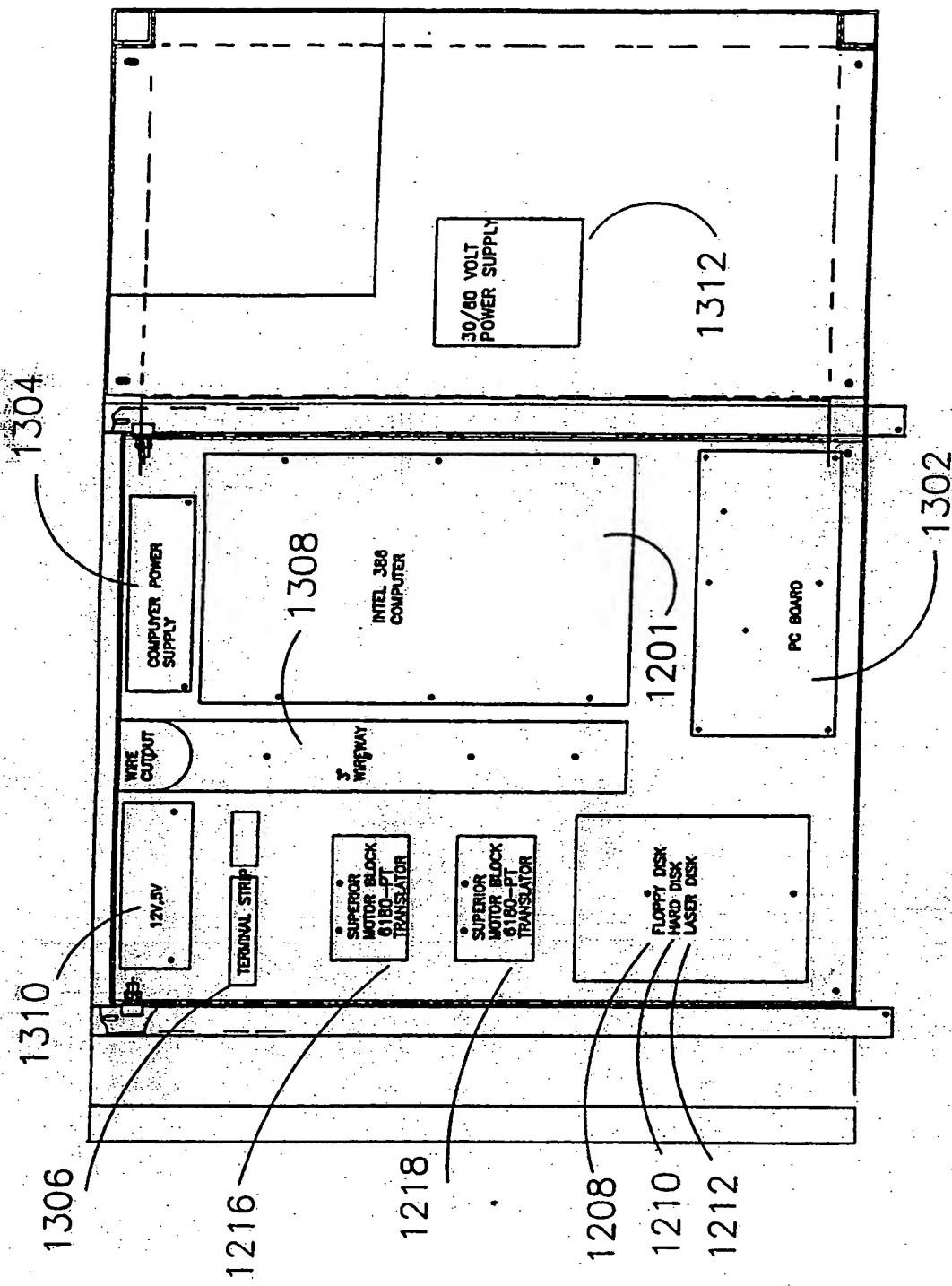


Figure 13

16/45

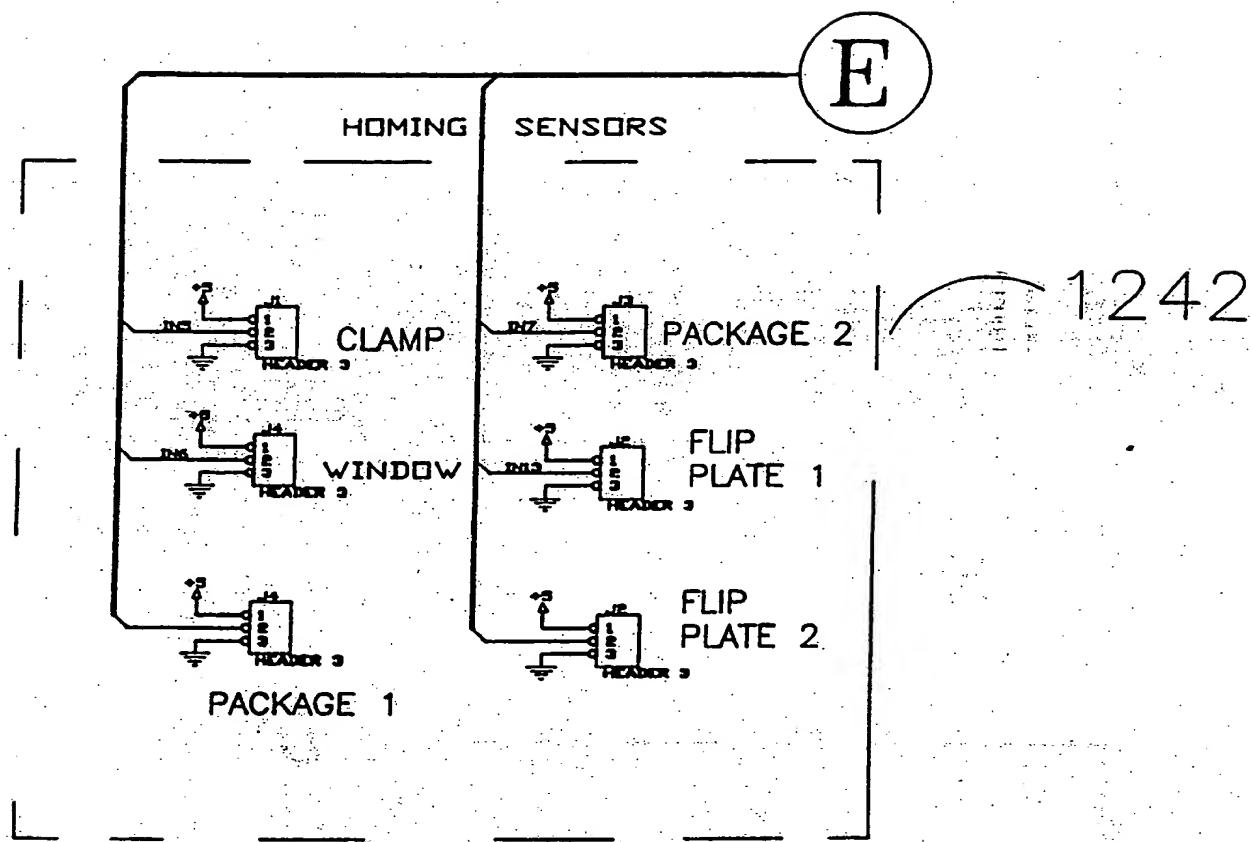


Figure 14a

17/45

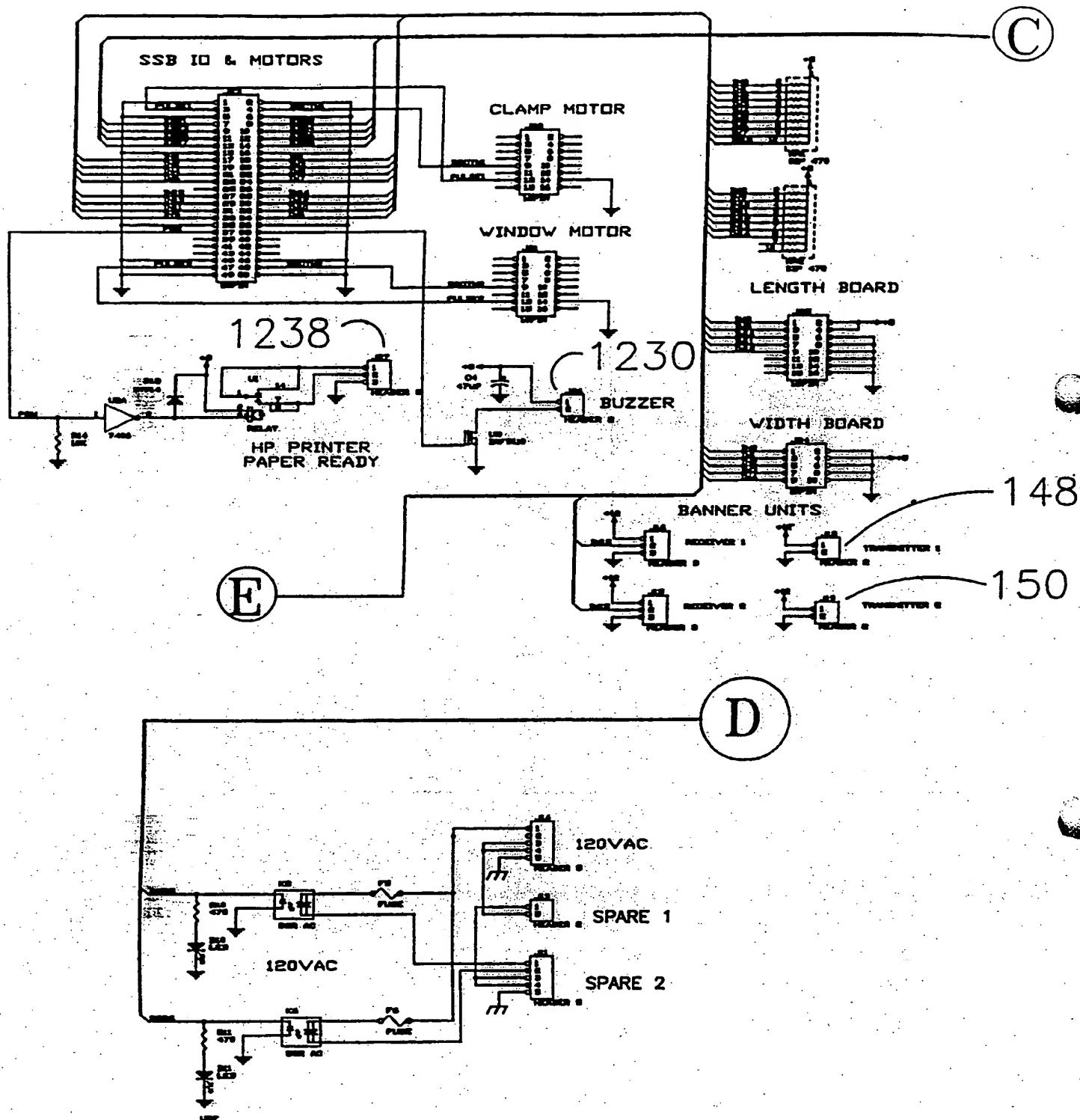


Figure 14b

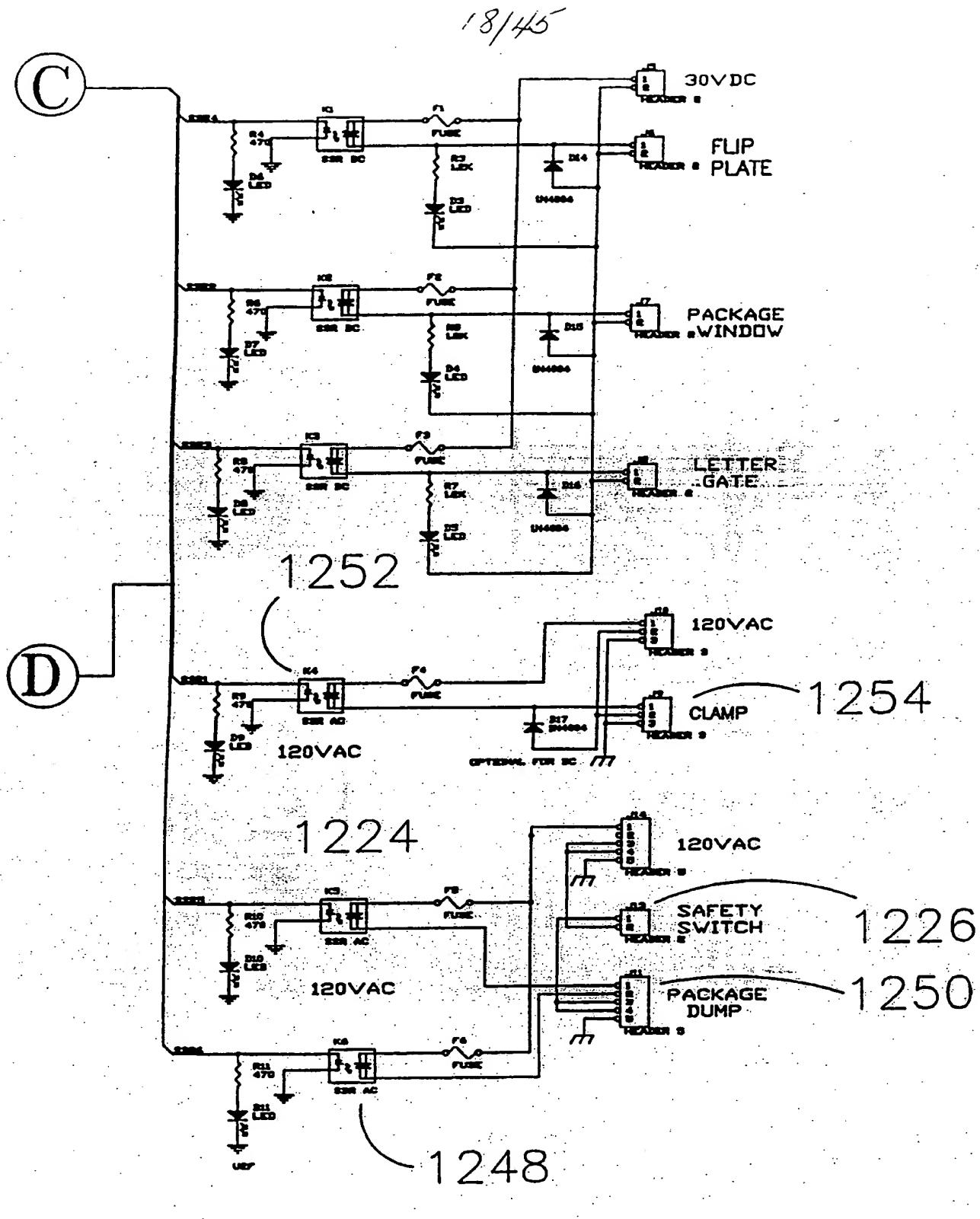


Figure 14c

19/45

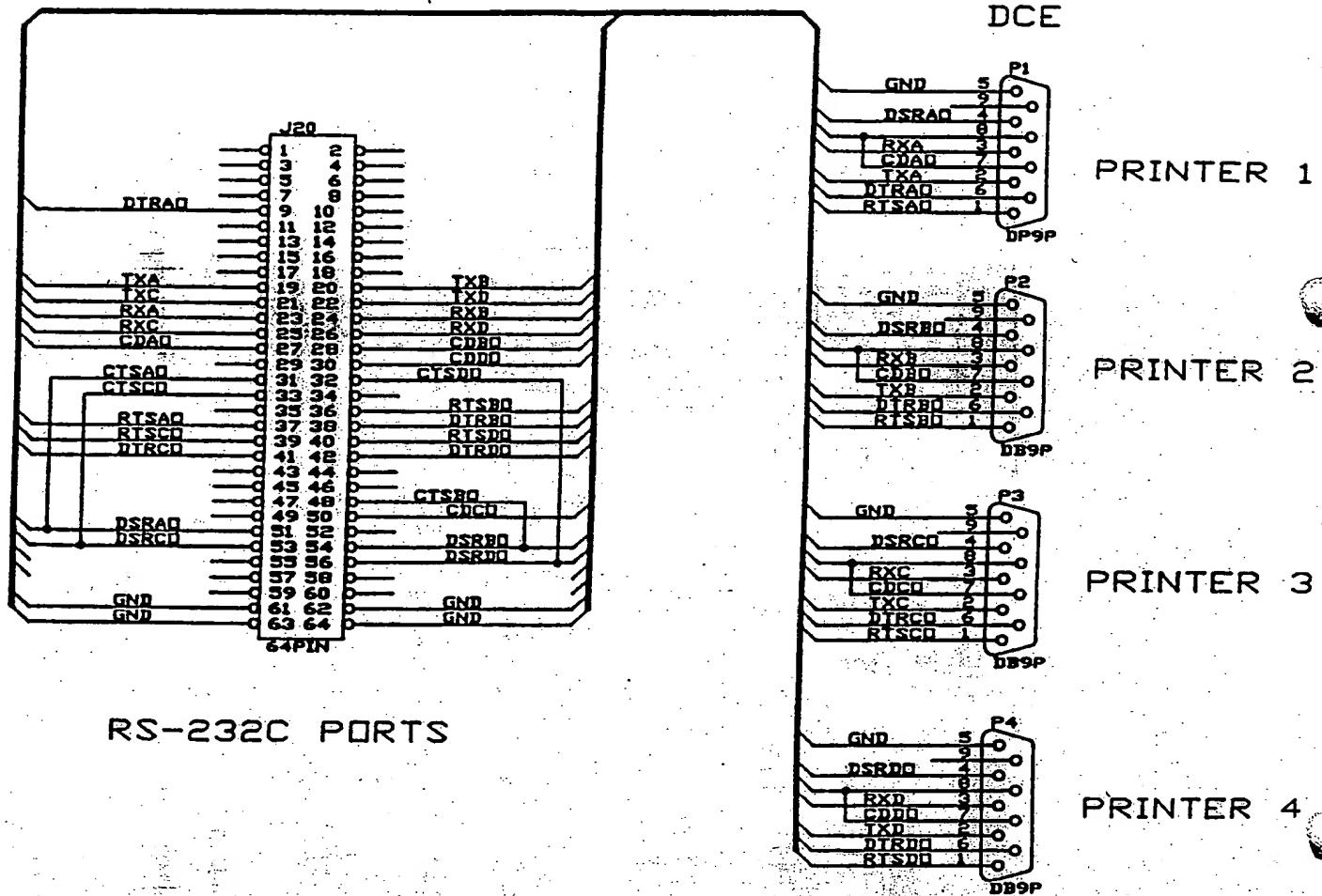


Figure 15

20/20'

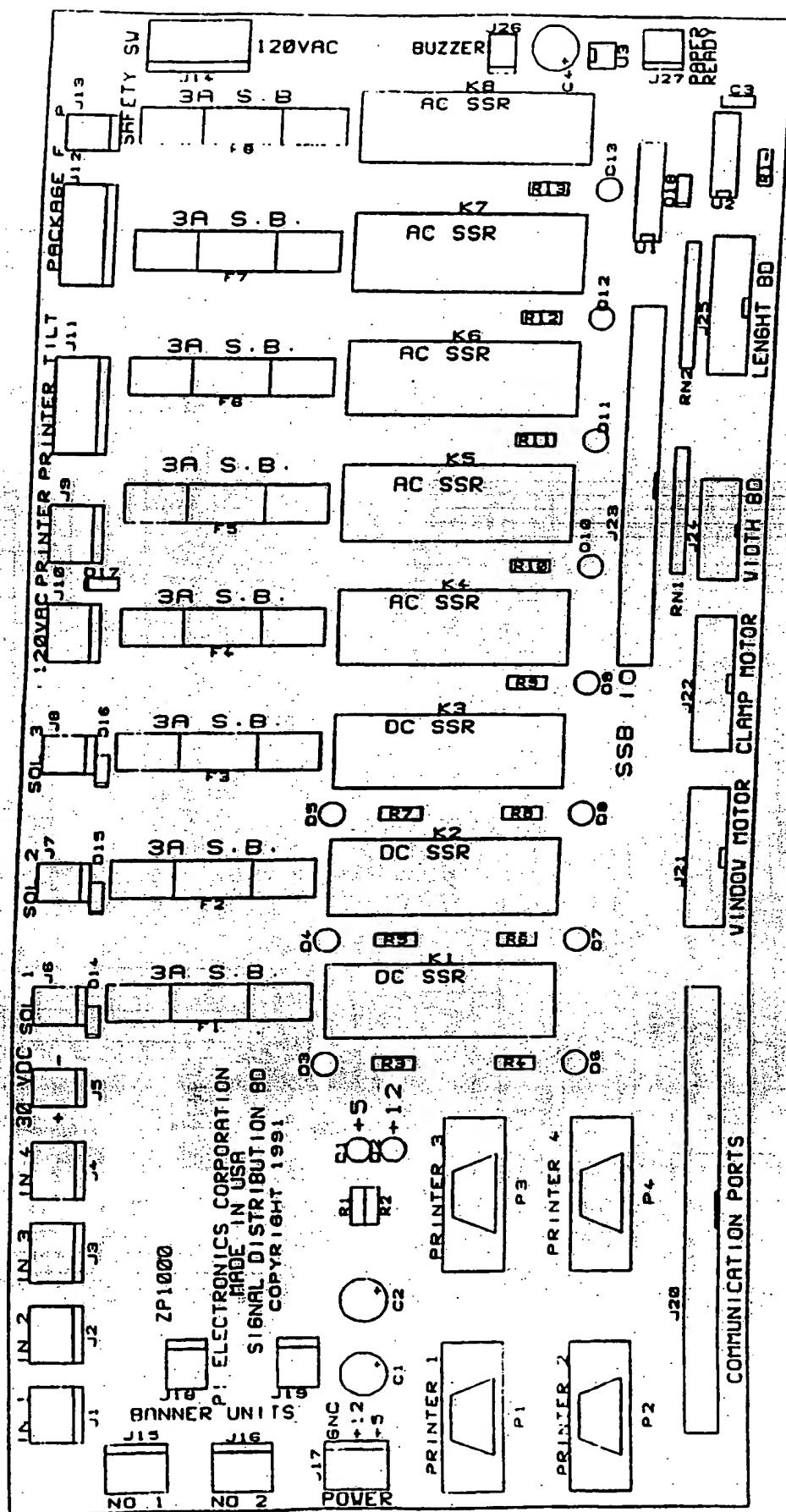


Figure 16

## **SUBSTITUTE SHEET**

21/45

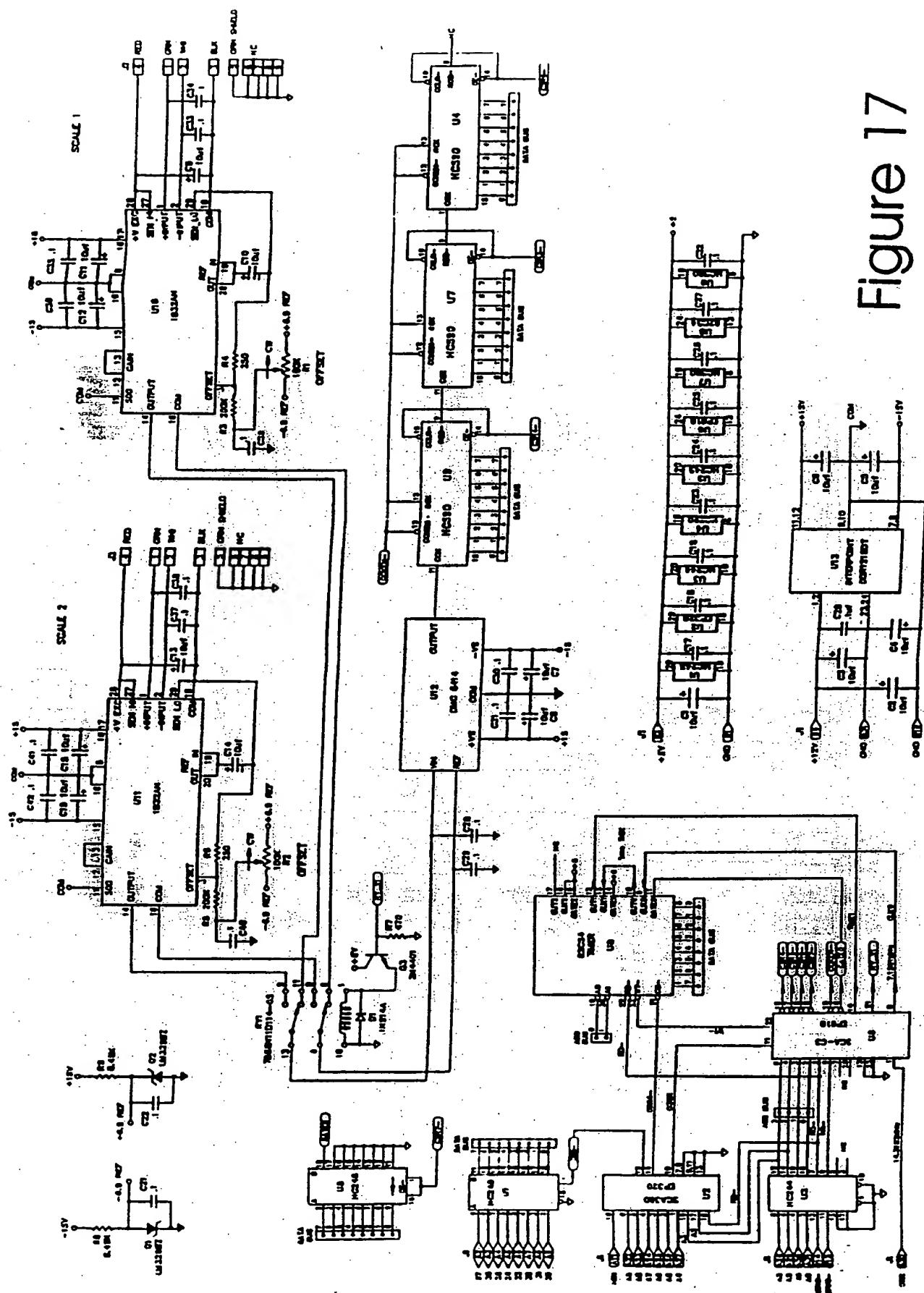


Figure 17

22/46

## Pi ELECTRONICS CORP

17-Nov-89

BOARD  
SCALE DBFILE  
SCALE.WK1

CKT REF	PART #	DESCRIPTION	MANUFACT	SUPPLIER	PER BD.
U01,5	MC74HC245N	OCTAL, TS, BUS, XCVR	MOTOROLA	HALL-MARK	2
U02	EP320DC-2	EPLD, 20-PIN	ALTERA, TI	MARSHALL	1
U03	MC74HC244N	OCTAL, TS, INV BUS DRV	MOTOROLA	HALL-MARK	1
U04,7,9	SN74HC590AN	8-BIT, CNTR, BUF T-S	TI	MARSHALL	3
U06	EP610DC-30	EPLD, 24-PIN	ALTERA, TI	MARSHALL	1
U08	CP82C54	TIMER, CMOS	HARRIS	SCHWEBER	1
U10,11	1B32AN	LOADCELL, AMP, EXCIT	ANALOG DEV	ANALOG DEV	2
U12	DMC8414	V/F, 1MHz	DYMEC	DYMEC	1
U13	DDR1215DT	DC-DC CONV, 12-15V	INTERPOINT	INTERPOINT	1
R01,2	3299X-1-104	POT, 100K	BOURNS	ANY	2
R03,5	200K	RES, CF, 1/4W, 5%	ANY	ANY	2
R04,6	250	RES, CF, 1/4W, 5%	ANY	ANY	2
R07	470	RES, CF, 1/4W, 5%	ANY	ANY	1
R08,9	6.49K	RES, MF, RN55D, 1%	ANY	ANY	2
C01-16	199D106X9025CA1	10UF, 25V, 20%, TANT	SPRAGUE	MARSHALL	16
C17-42	CW20C104K	.1UF, 50V, 10%	CENTRLAB	MARSHALL	26
Q03	2N4401	NPN, TRAN, SIG	MOTOROLA	SCHWEBER	1
Q01,2	LM329BZ	ZENER, REF, 6.9V	NATIONAL	SCHWEBER	2
D01	1N914A	DIODE, SIG	ANY	ANY	1
J02,3	747844-4	DB9, RT ANG, FEMALE	AMP	KENT	2
	205817-1	NUTS, 10-40, FOR ABOVE AMP		KENT	2
RY01	TB85N11D114-05	RELAY, SPDT	P&B	HARRISON	1
BD	PCB 50011-01	BOARD,	Pi	Pi	1

Figure 17.1

23/45

## Pi ELECTRONICS CORP

17-Nov-89

BOARD  
SCALE DBFILE  
SCALE.WK1

CKT REF	PART #	DESCRIPTION	MANUFACT	SUPPLIER	PER BD.
U10,11	1B32AN	LOADCELL, AMP, EXCIT	ANALOG DEV	ANALOG DEV	2
R03,5	200K	RES, CF, 1/4W, 5%	ANY	ANY	2
R04,6	250 $\Omega$	RES, CF, 1/4W, 5%	ANY	ANY	2
D01	1N914A	DIODE, SIG	ANY	ANY	1
R08,9	6.49K	RES, MF, RN55D, 1%	ANY	ANY	2
R01,2	3299X-1-104	POT, 100K	BOURNS	ANY	2
R07	470	RES, CF, 1/4W, 5%	ANY	ANY	1
U12	DMC8414	V/F, 1MHz	DYMEC	DYMEC	1
U01,5	MC74HC245N	OCTAL, TS, BUS, XCVR	MOTOROLA	HALL-MARK	2
U03	MC74HC244N	OCTAL, TS, INV BUS DRV	MOTOROLA	HALL-MARK	1
RY01	TB85N11D114-05	RELAY, SPDT	P&B	HARRISON	1
U13	DDR1215DT	DC-DC CONV, 12-15V	INTERPOINT	INTERPOINT	1
J02,3	747844-4	DB9, RT ANG, FEMALE	AMP	KENT	2
	205817-1	NUTS, 10-40, FOR ABOVE	AMP	KENT	2
U02	EP320DC-2	EPLD, 20-PIN	ALTERA, TI	MARSHALL	1
C01-16	199D106X9025CA1	10UF, 25V, 20%, TANT	SPRAGUE	MARSHALL	16
U06	EP610DC-30	EPLD, 24-PIN	ALTERA, TI	MARSHALL	1
C17-42	CW20C104K	.1UF, 50V, 10%	CENTRLAB	MARSHALL	26
U04,7,9	SN74HC590AN	8-BIT, CNTR, BUF T-S	TI	MARSHALL	3
BD	PCB 50011-01	BOARD,	Pi	Pi	1
Q03	2N4401	NPN, TRAN, SIG	MOTOROLA	SCHWEBER	1
Q01,2	LM329BZ	ZENER, REF, 6.9V	NATIONAL	SCHWEBER	2
U08	CP82C54	TIMER, CMOS	HARRIS	SCHWEBER	1

Figure 17.2

24/45

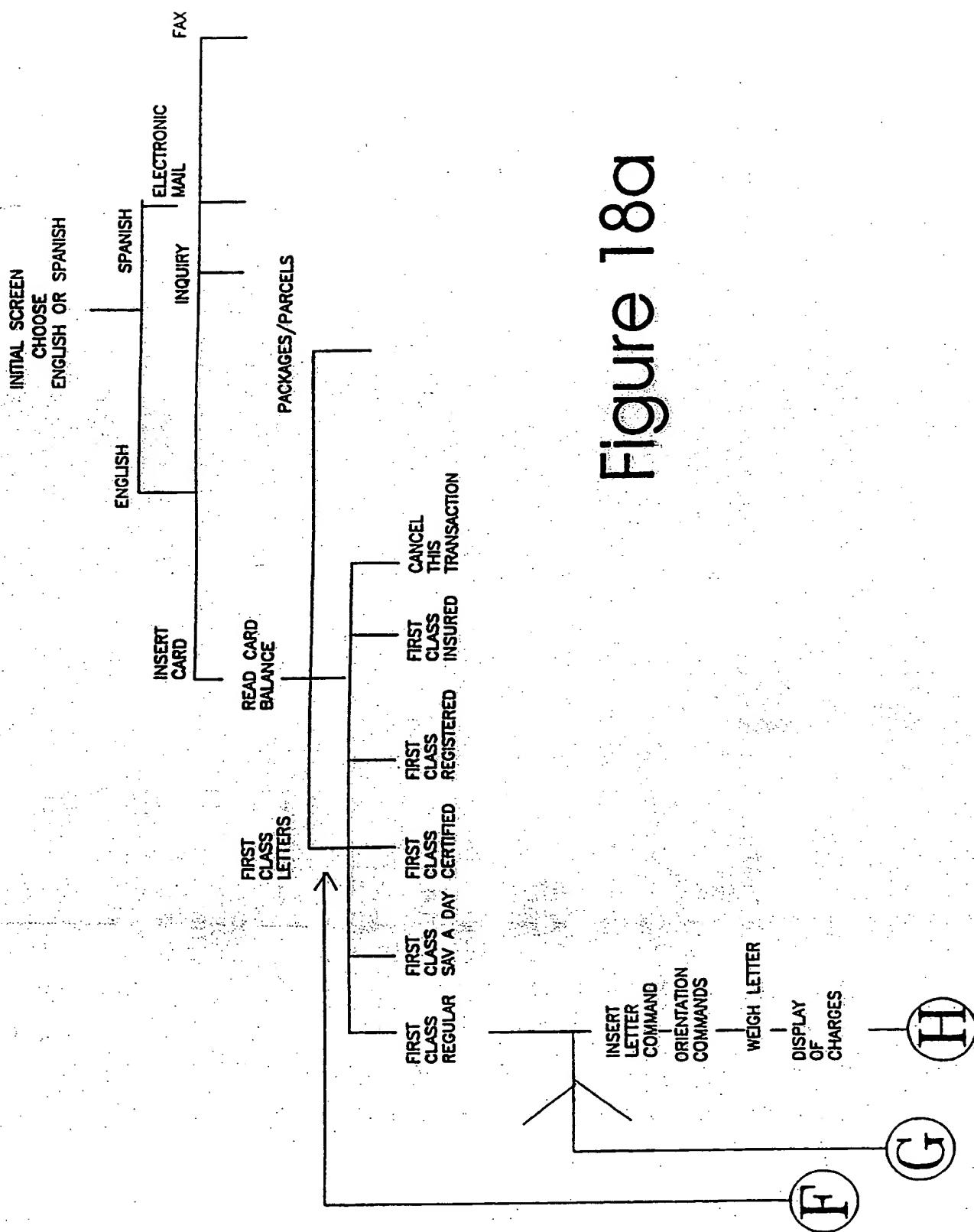


Figure 18a

25/45

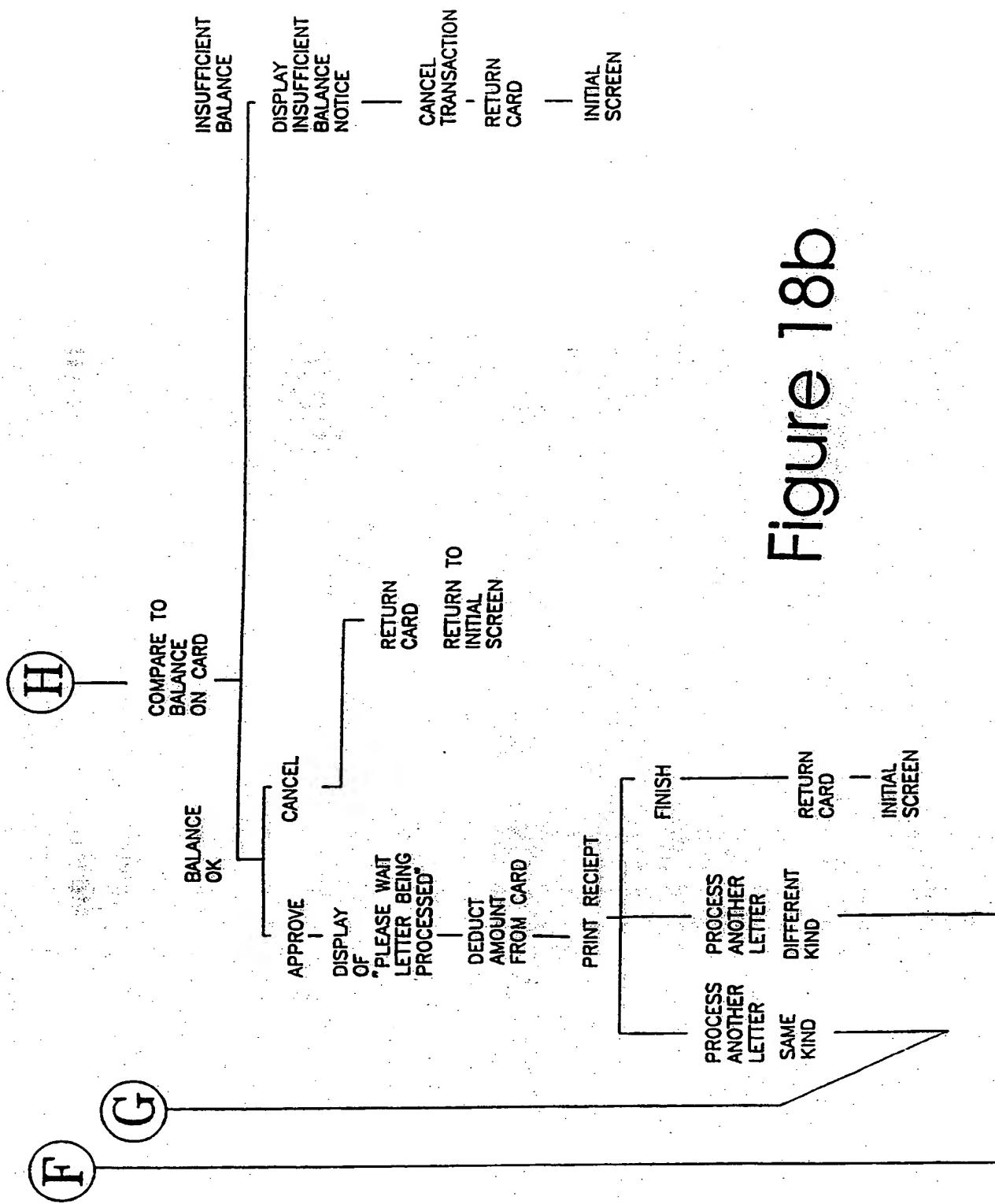
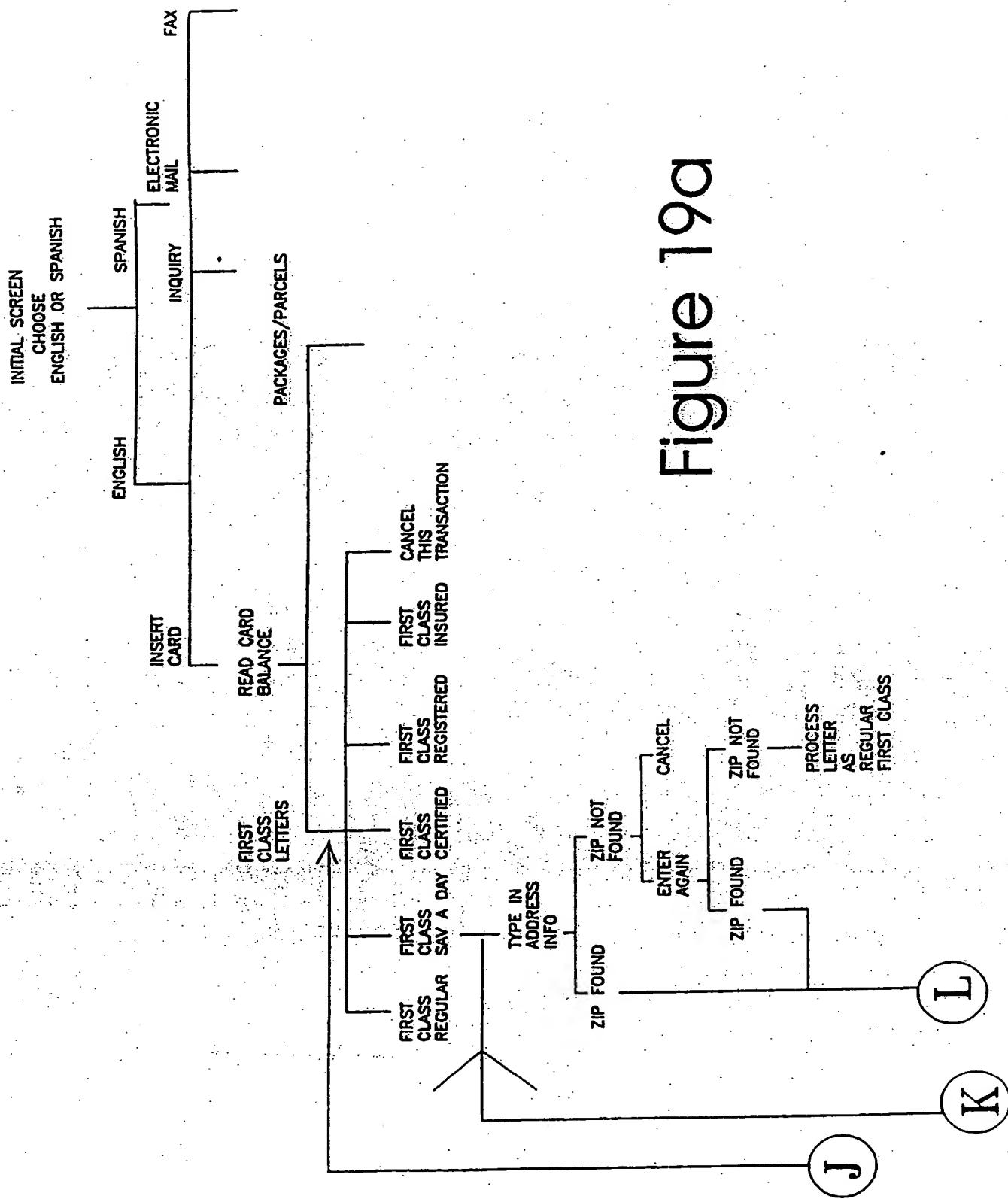


Figure 18b

SUBSTITUTE SHEET

26/45



27/45

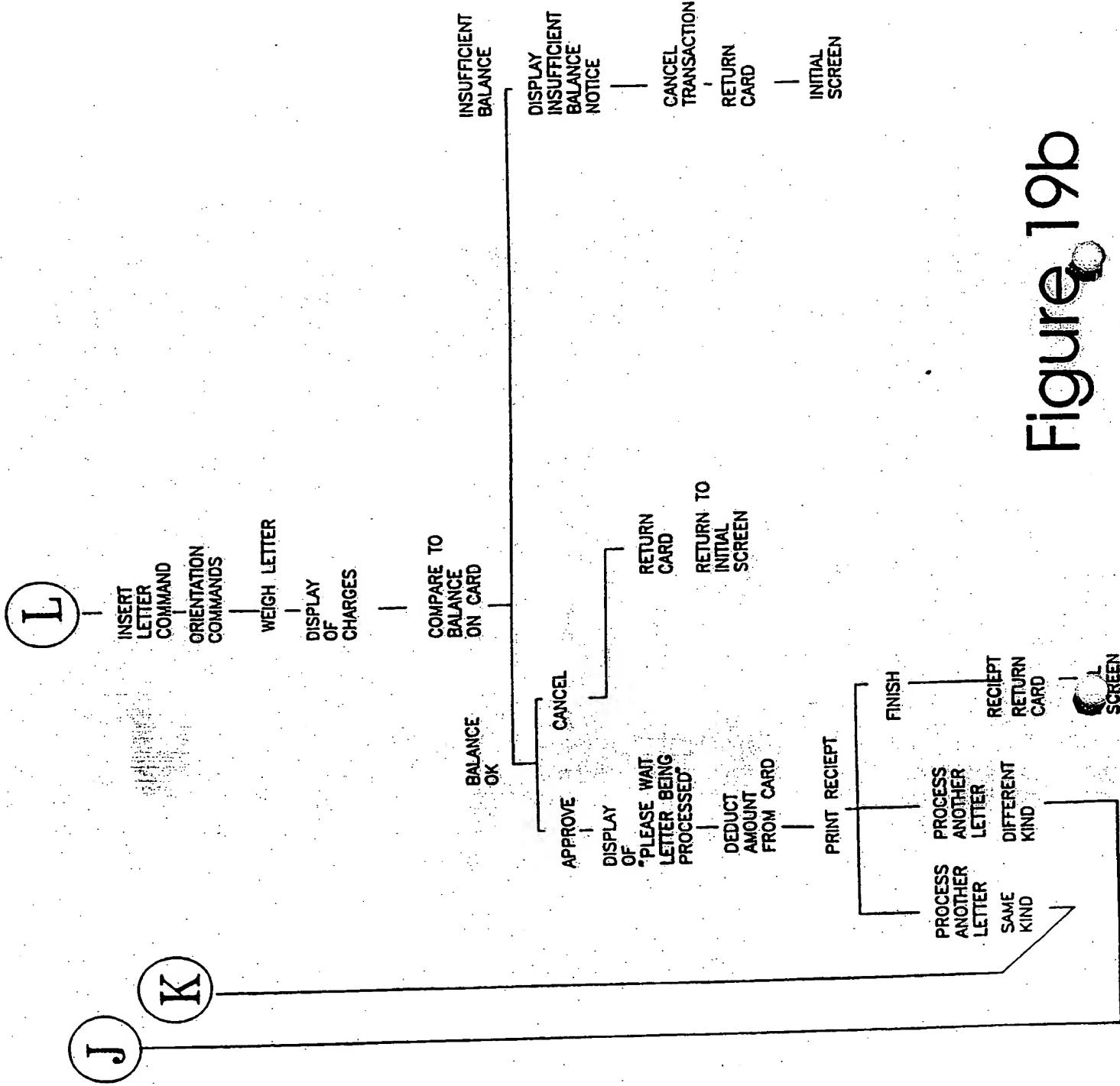


Figure 19b

28/45

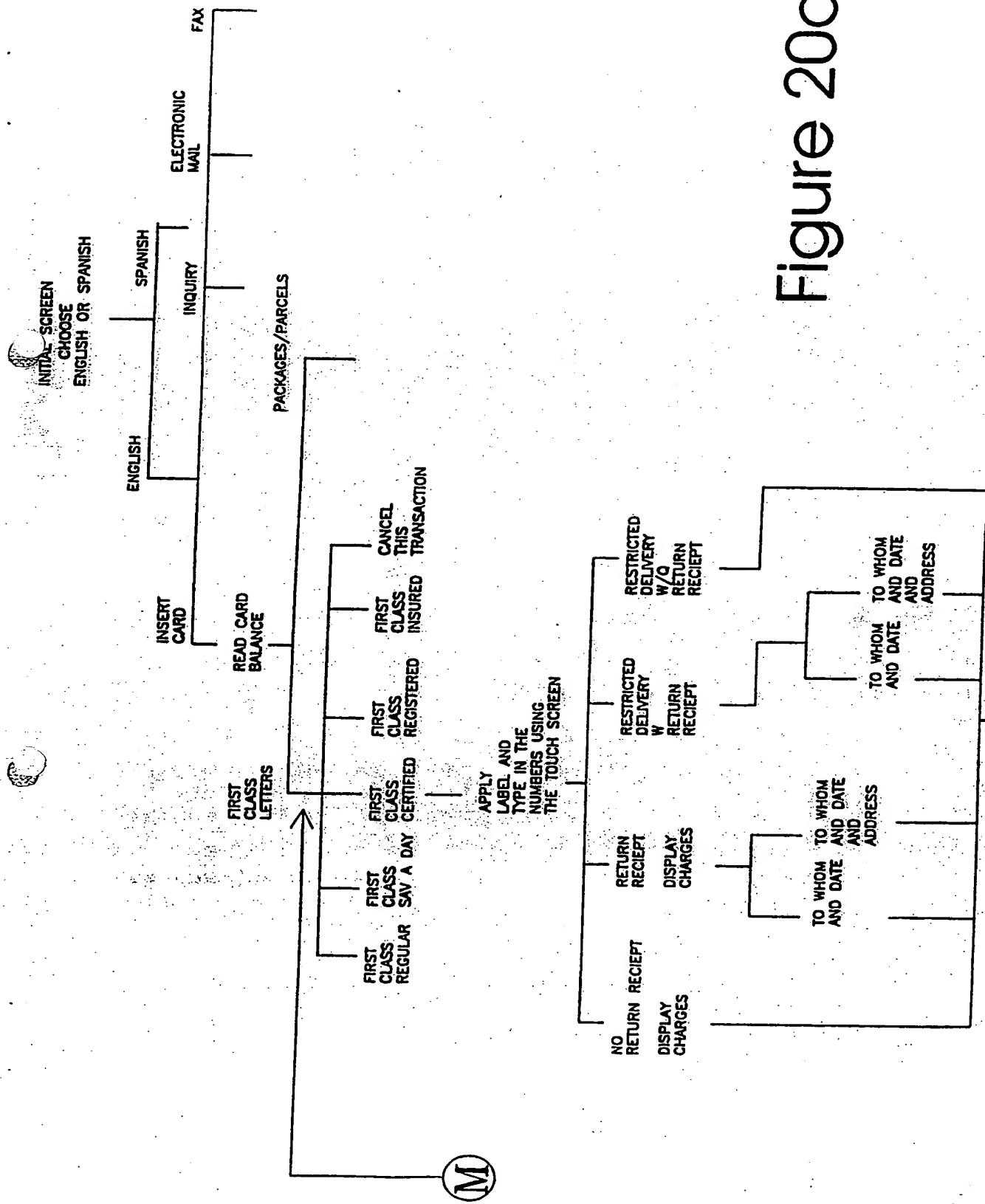
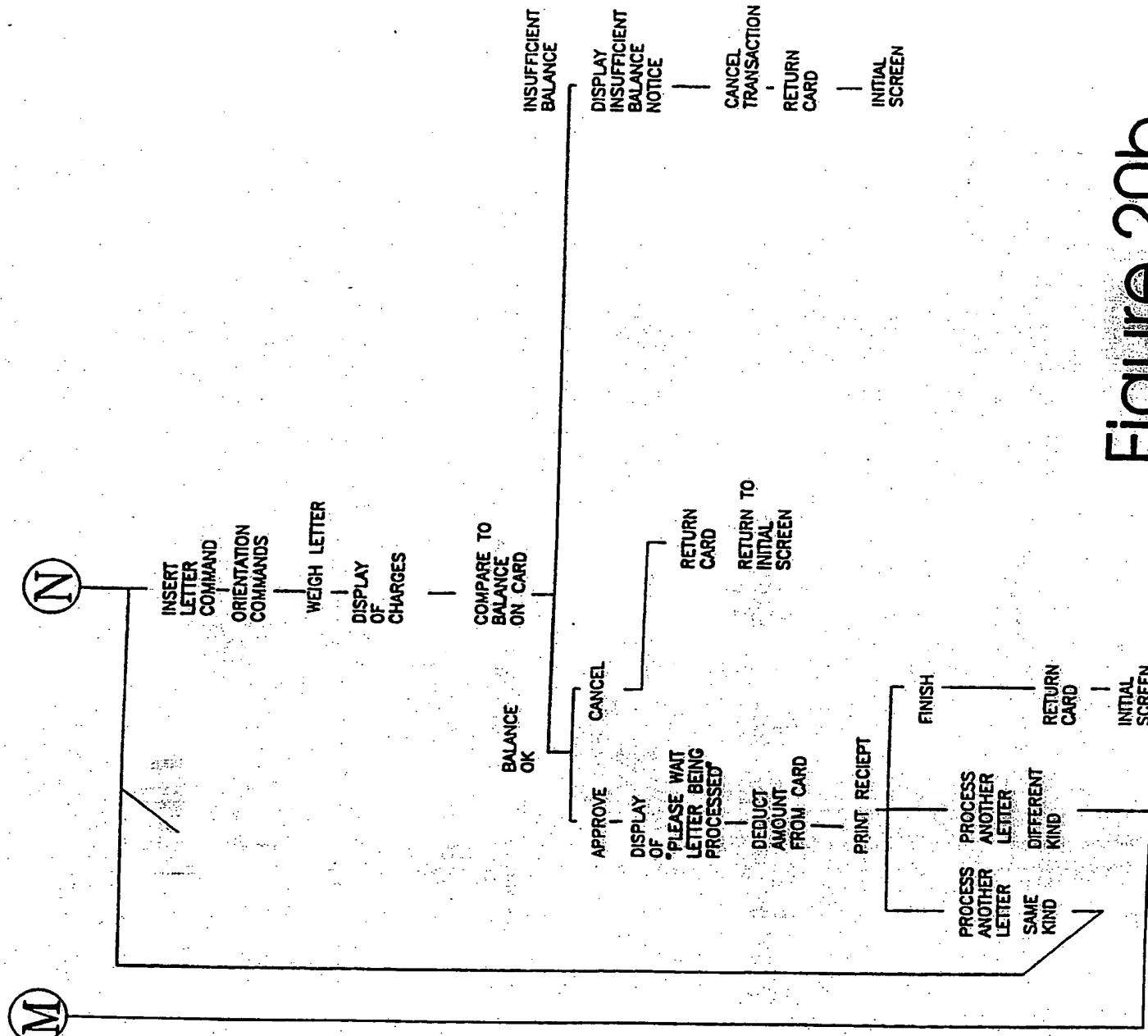


Figure 20a

29/45



**Figure 20b**

30/45

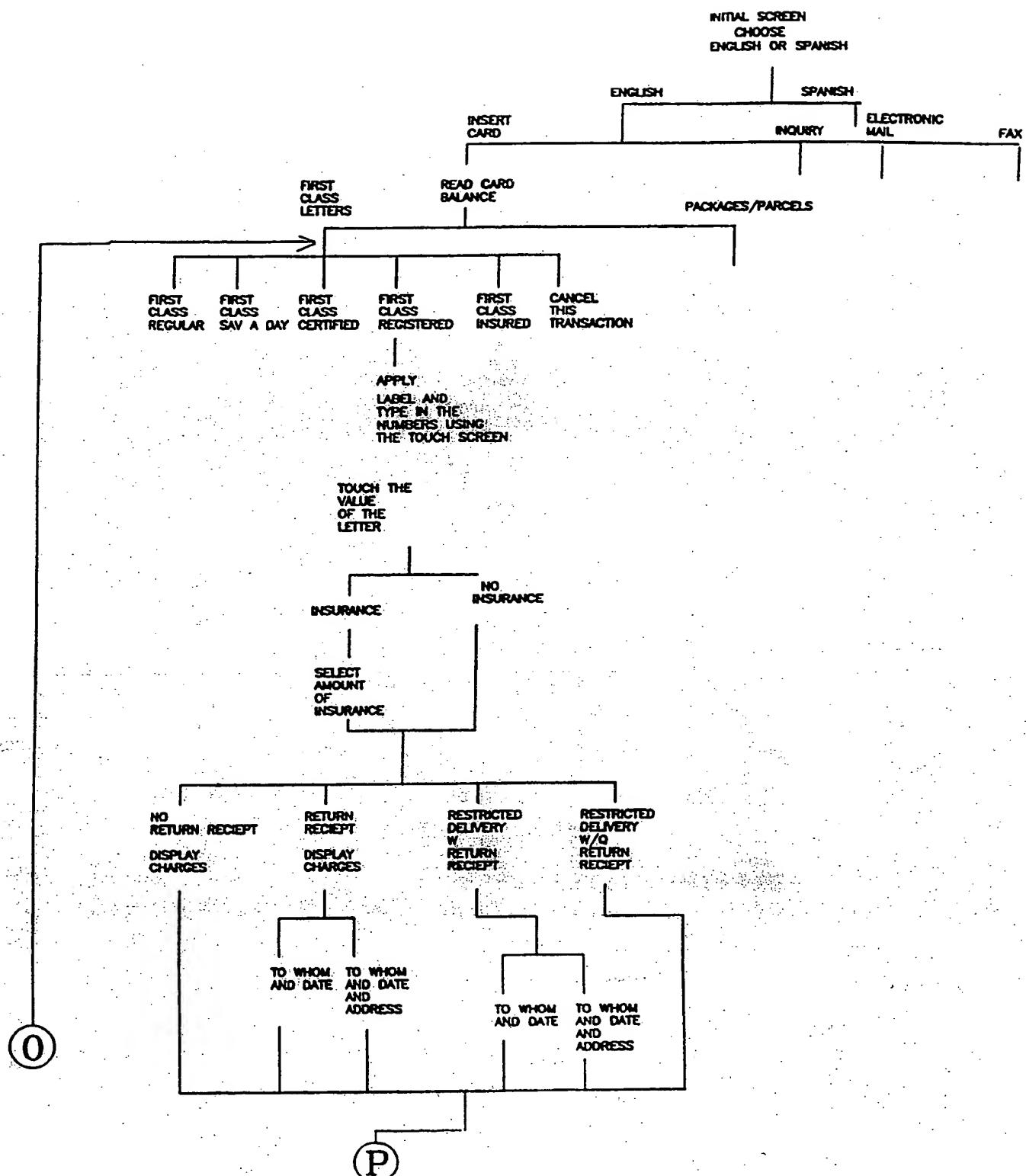


Figure 21a

31/45

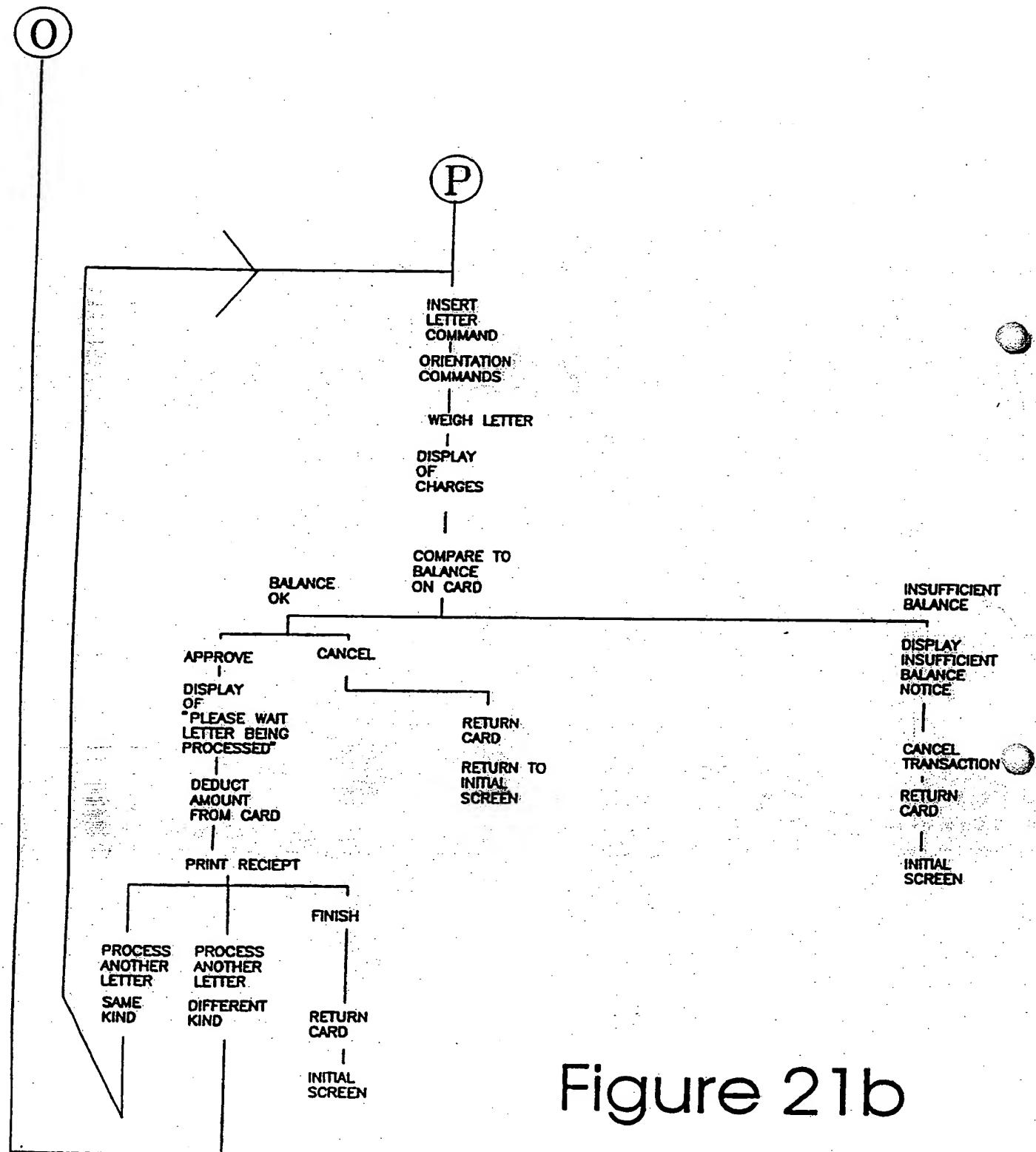
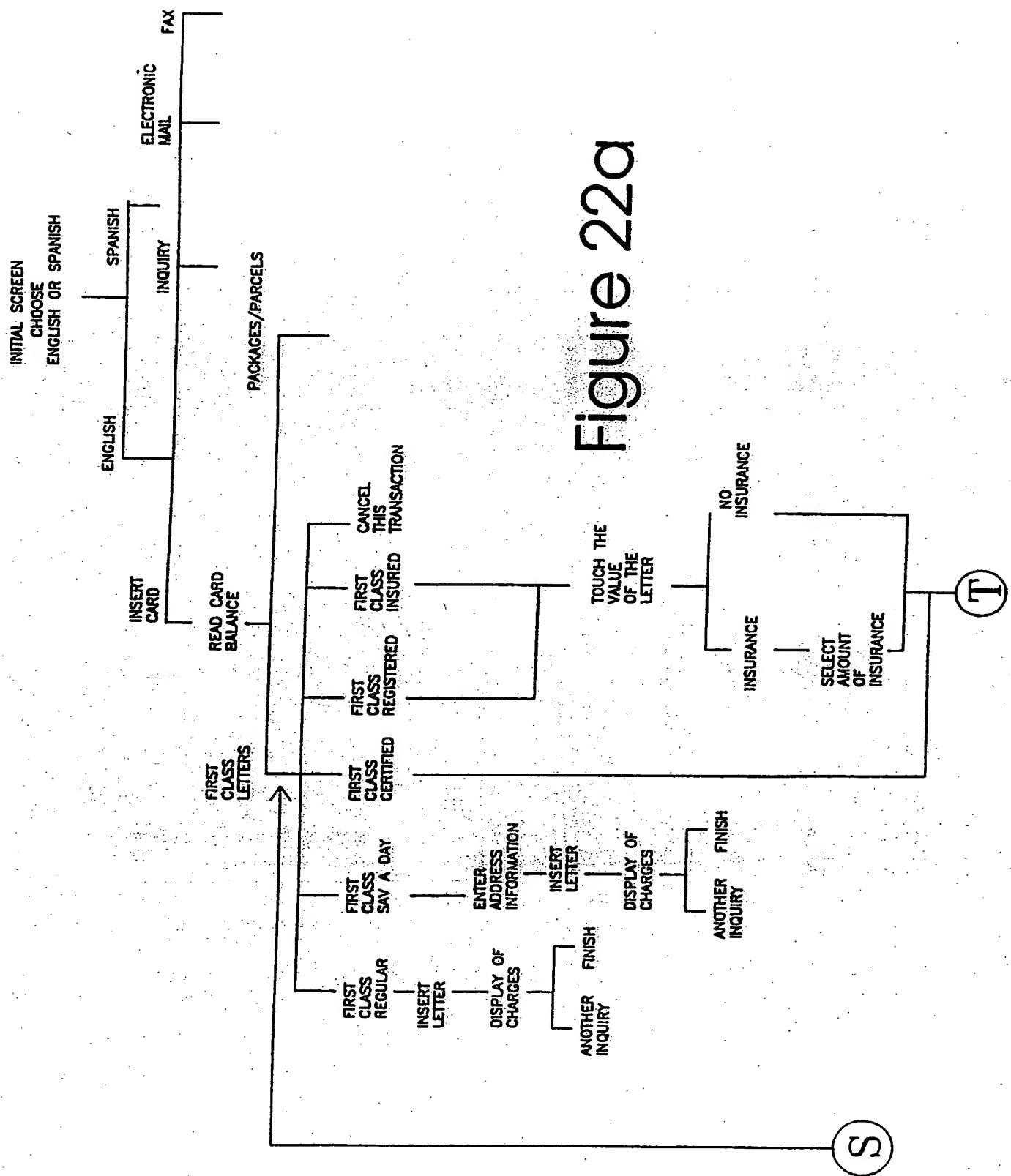


Figure 21b

32/45



33/43-

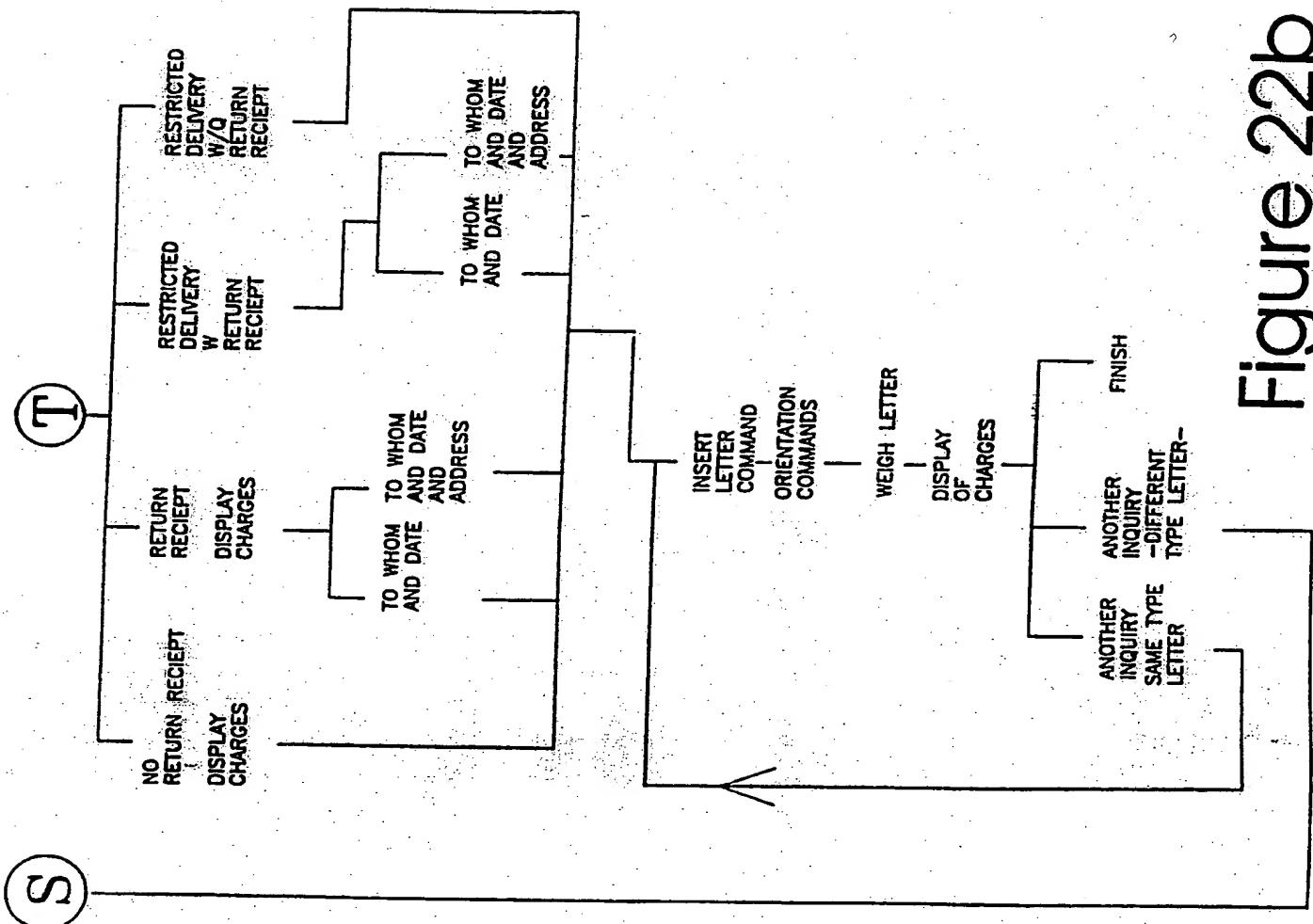


Figure 22b

34/45

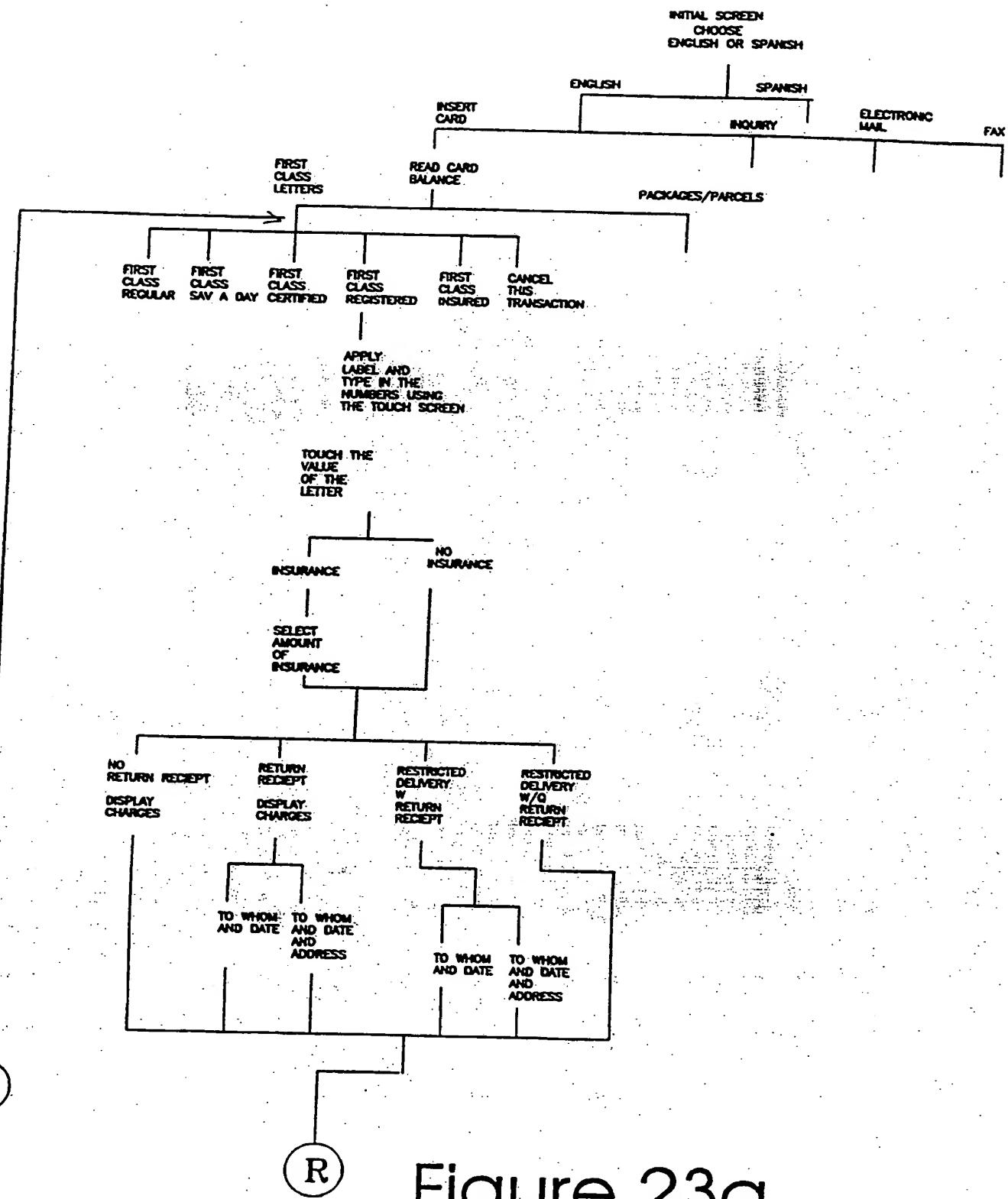
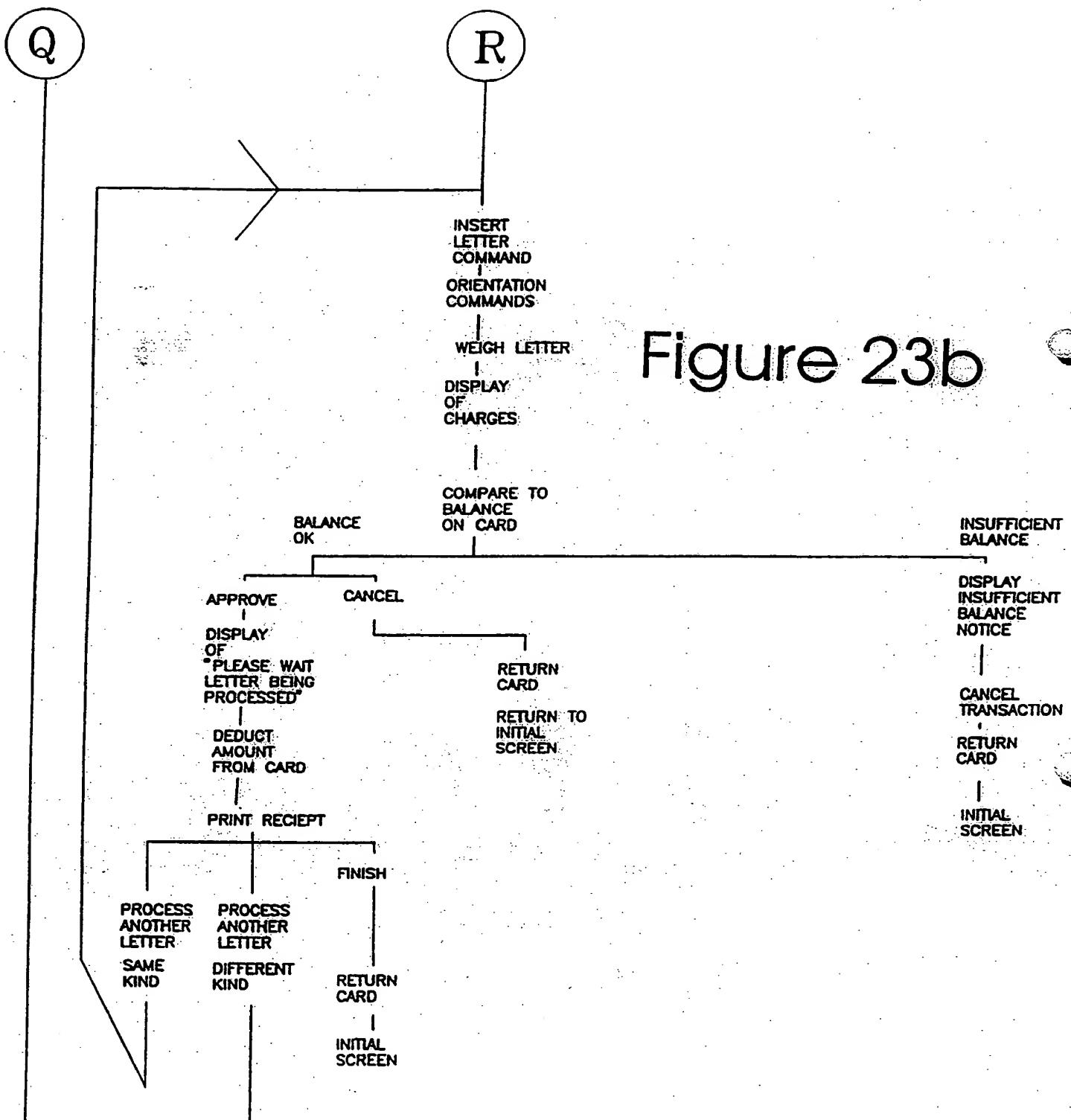


Figure 23a

35/45



36/45

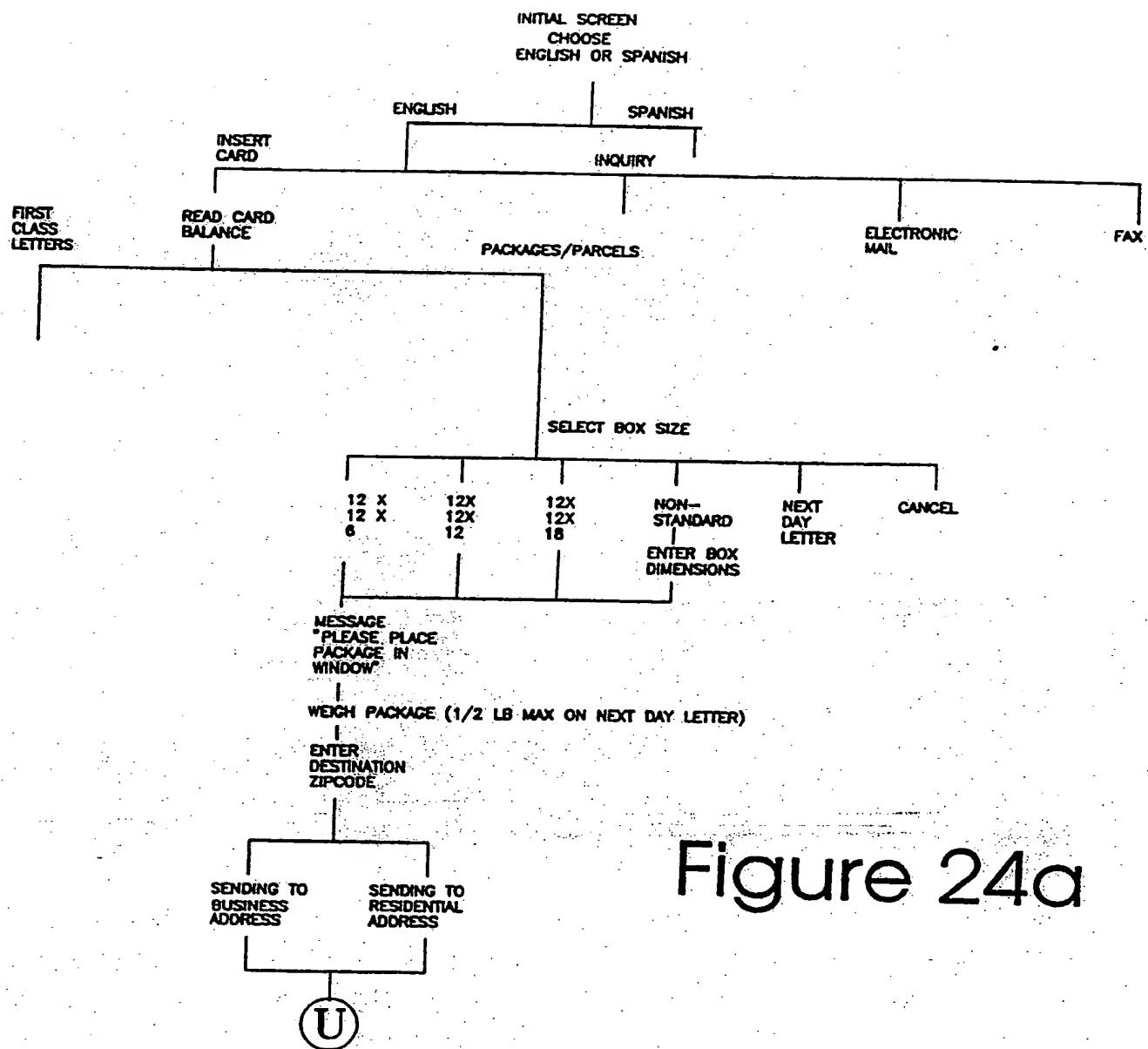


Figure 24a

37/45

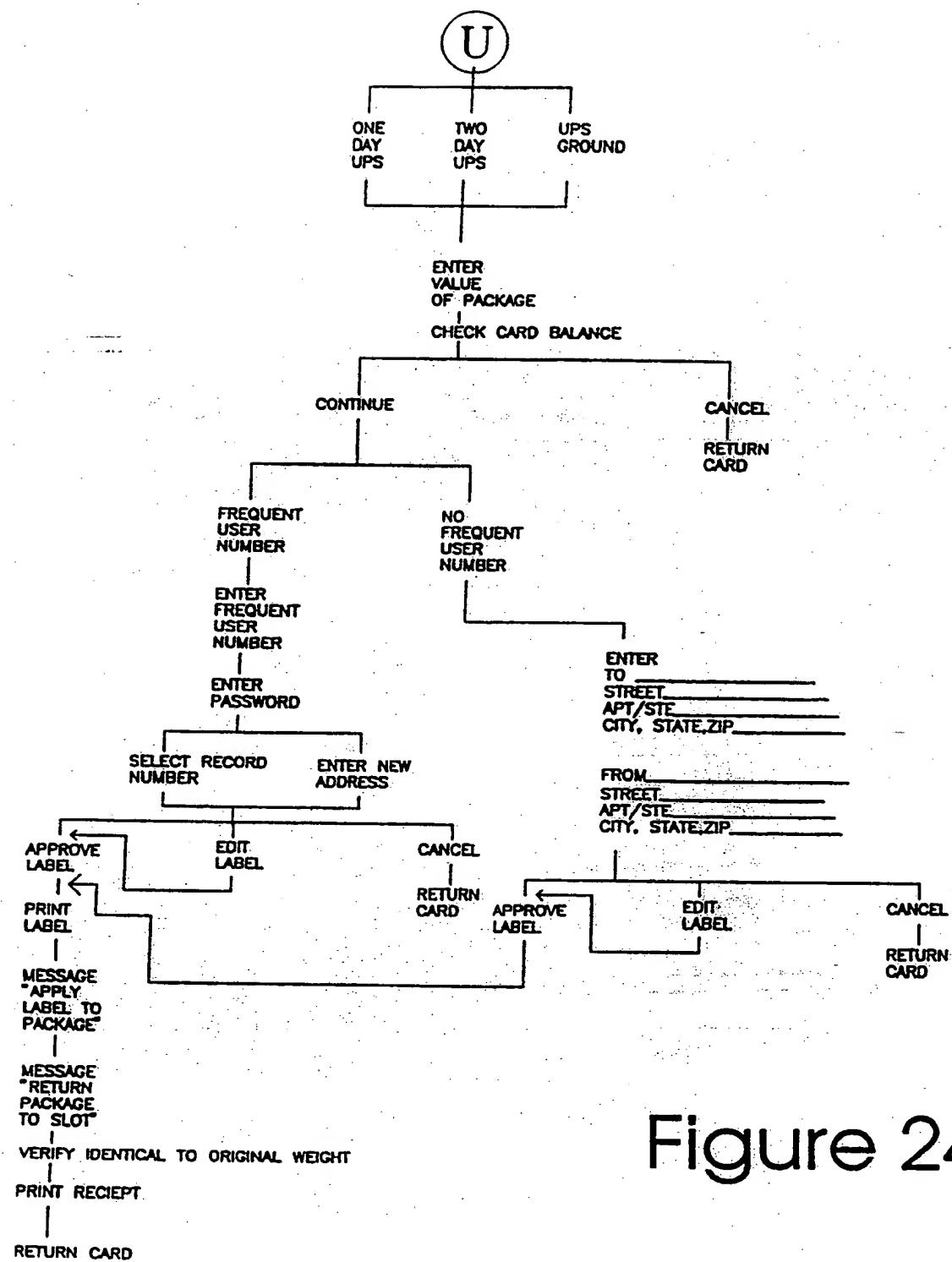


Figure 24b

38/45

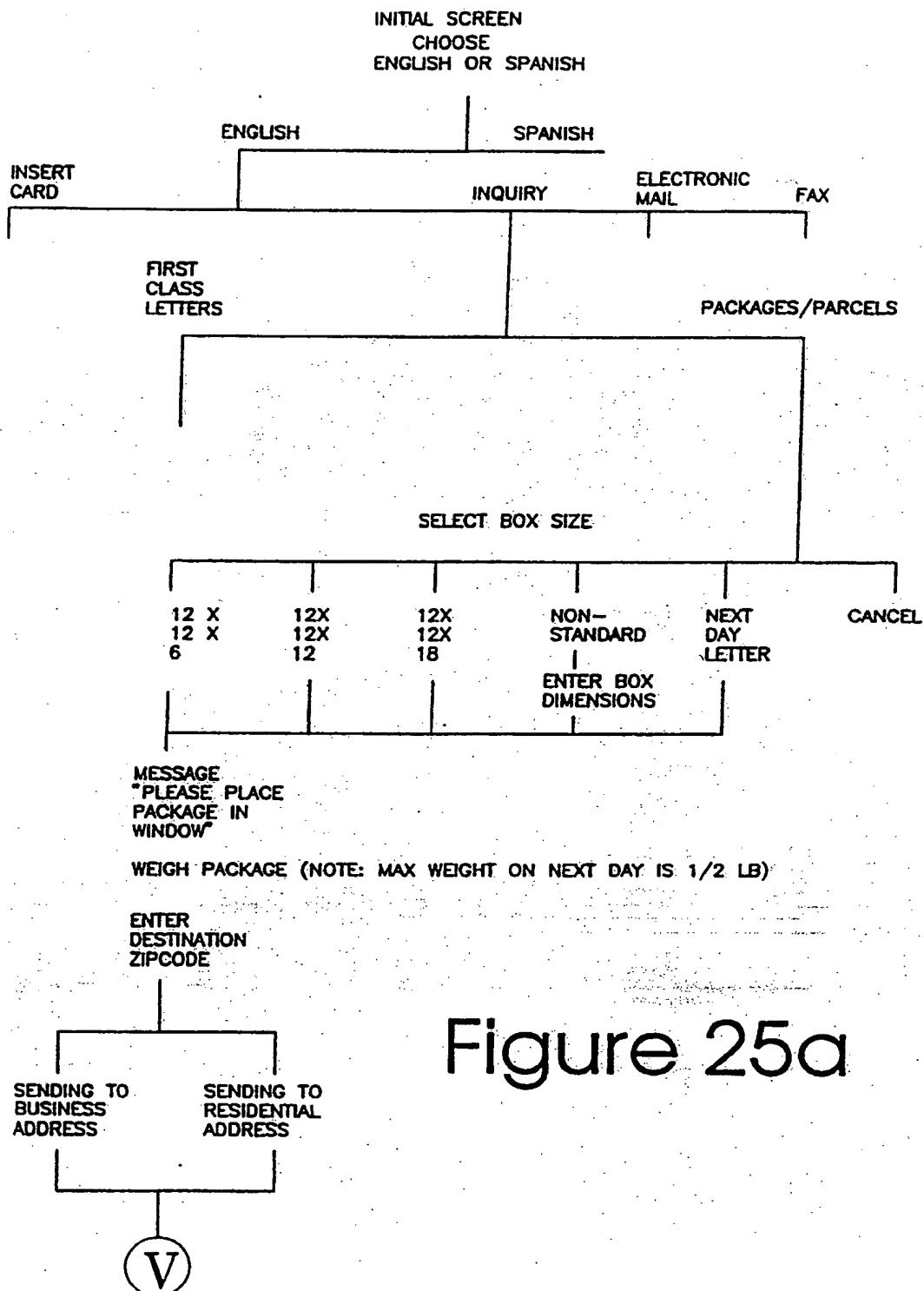


Figure 25a

39/45

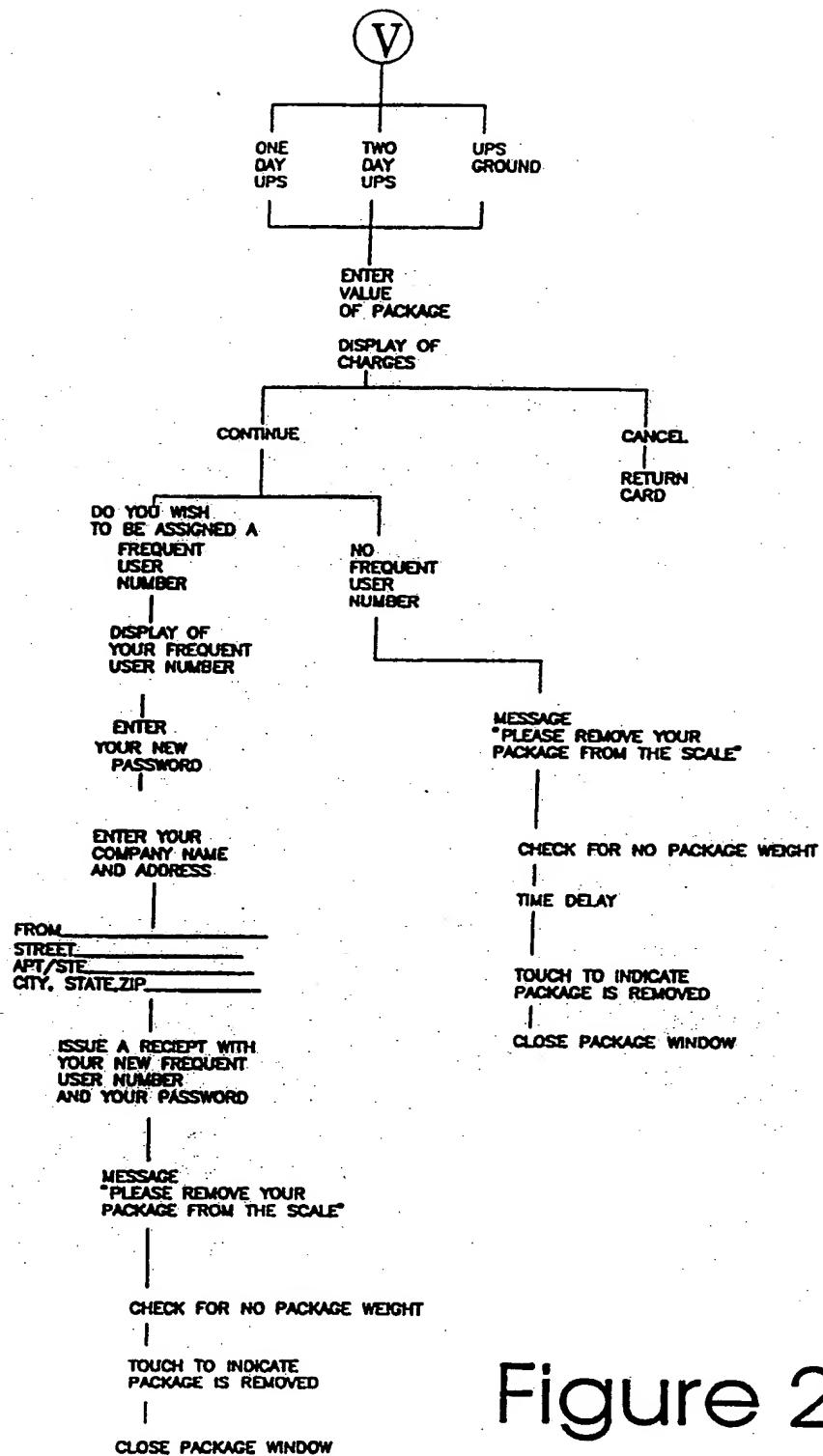


Figure 25b

SUBSTITUTE SHEET

40/45

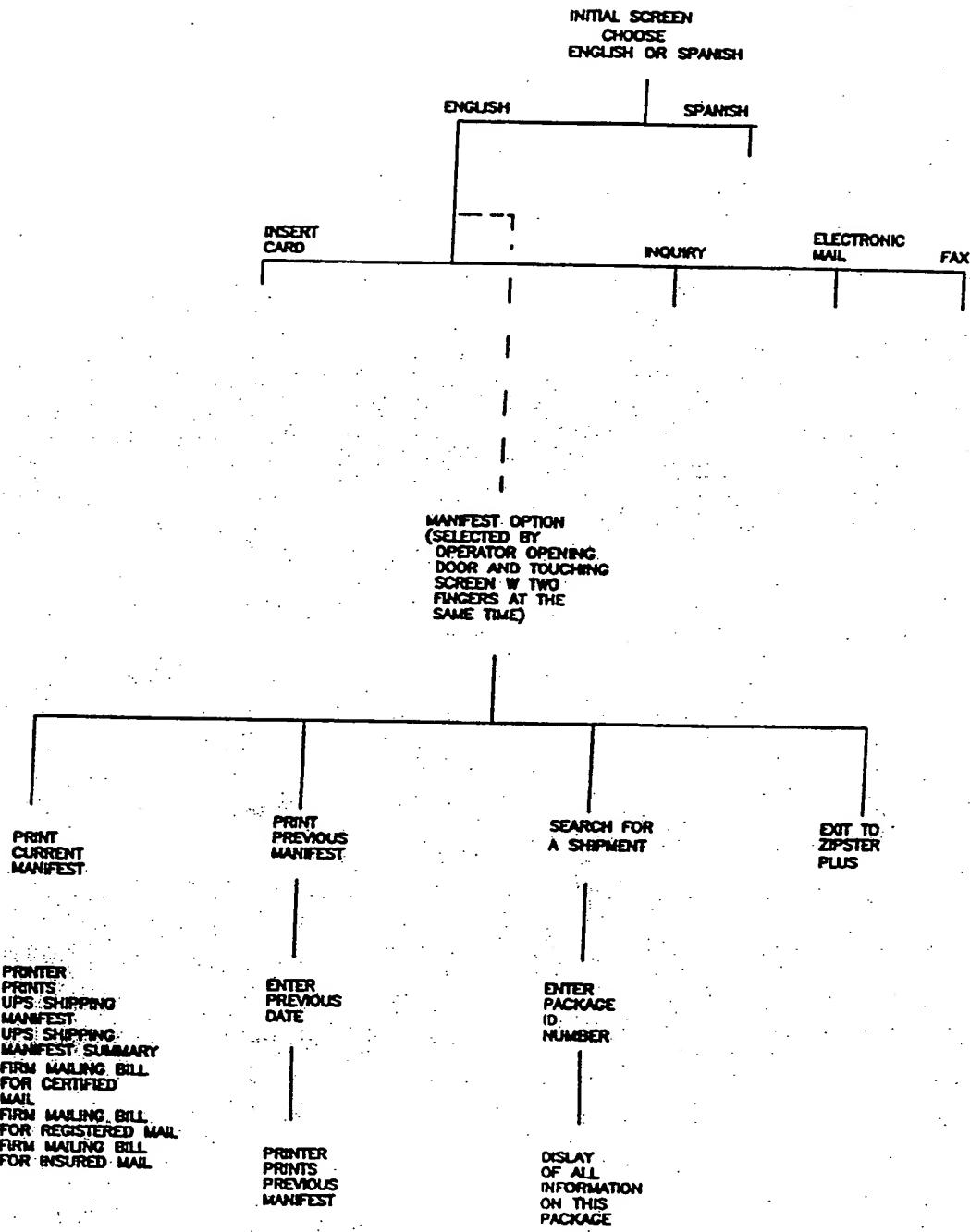


Figure 26

41/45

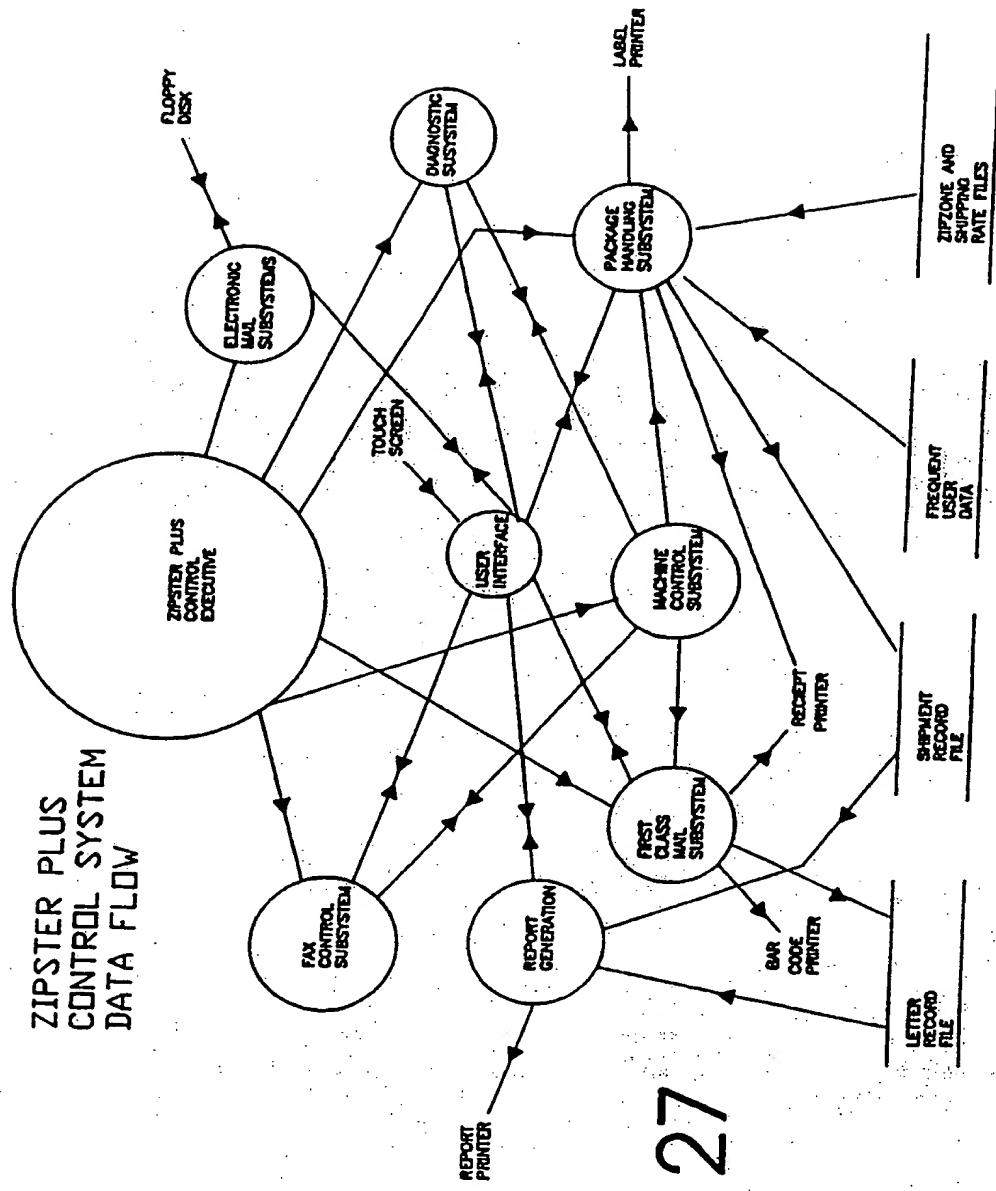


Figure 27

42/45

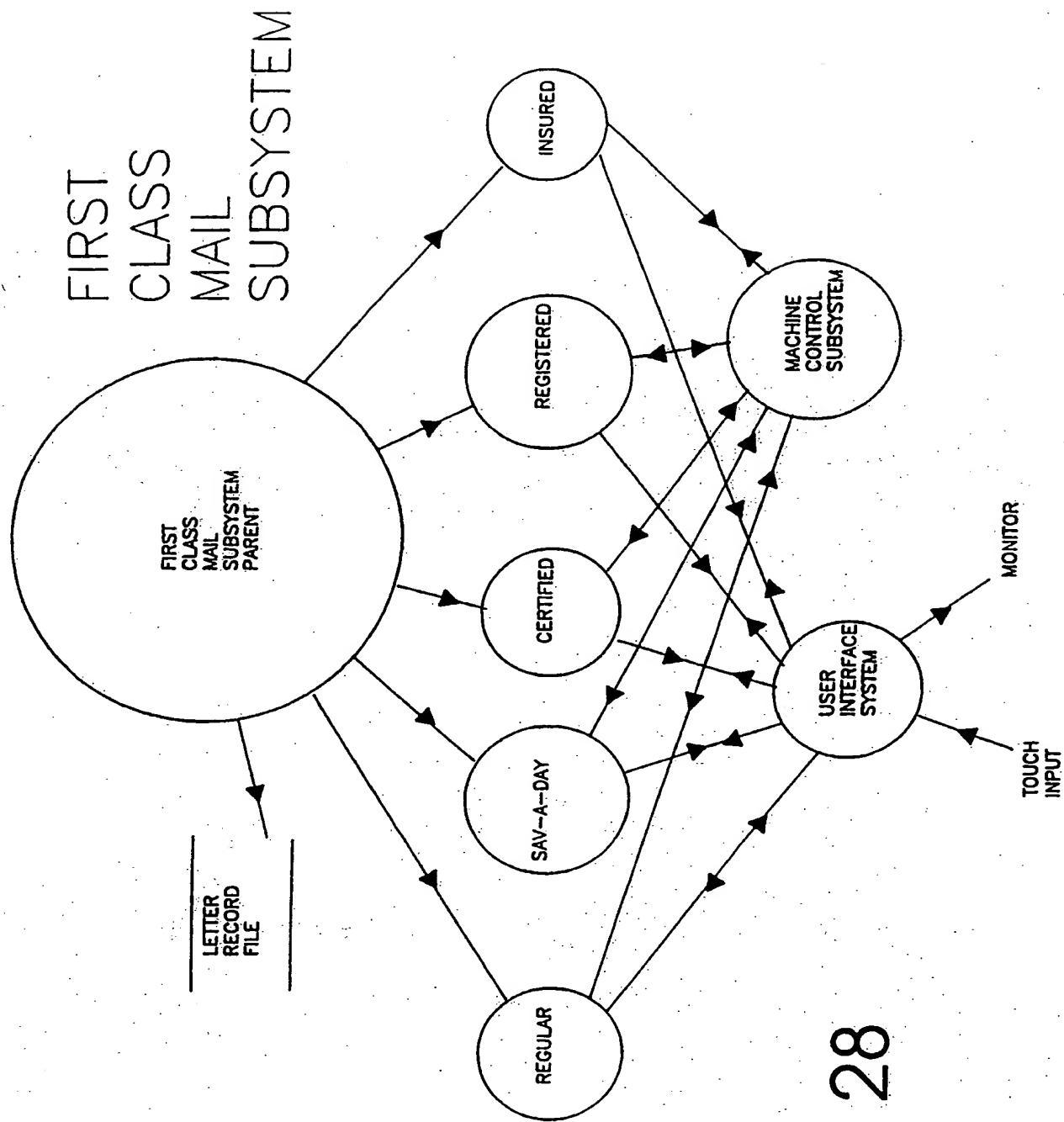


Figure 28

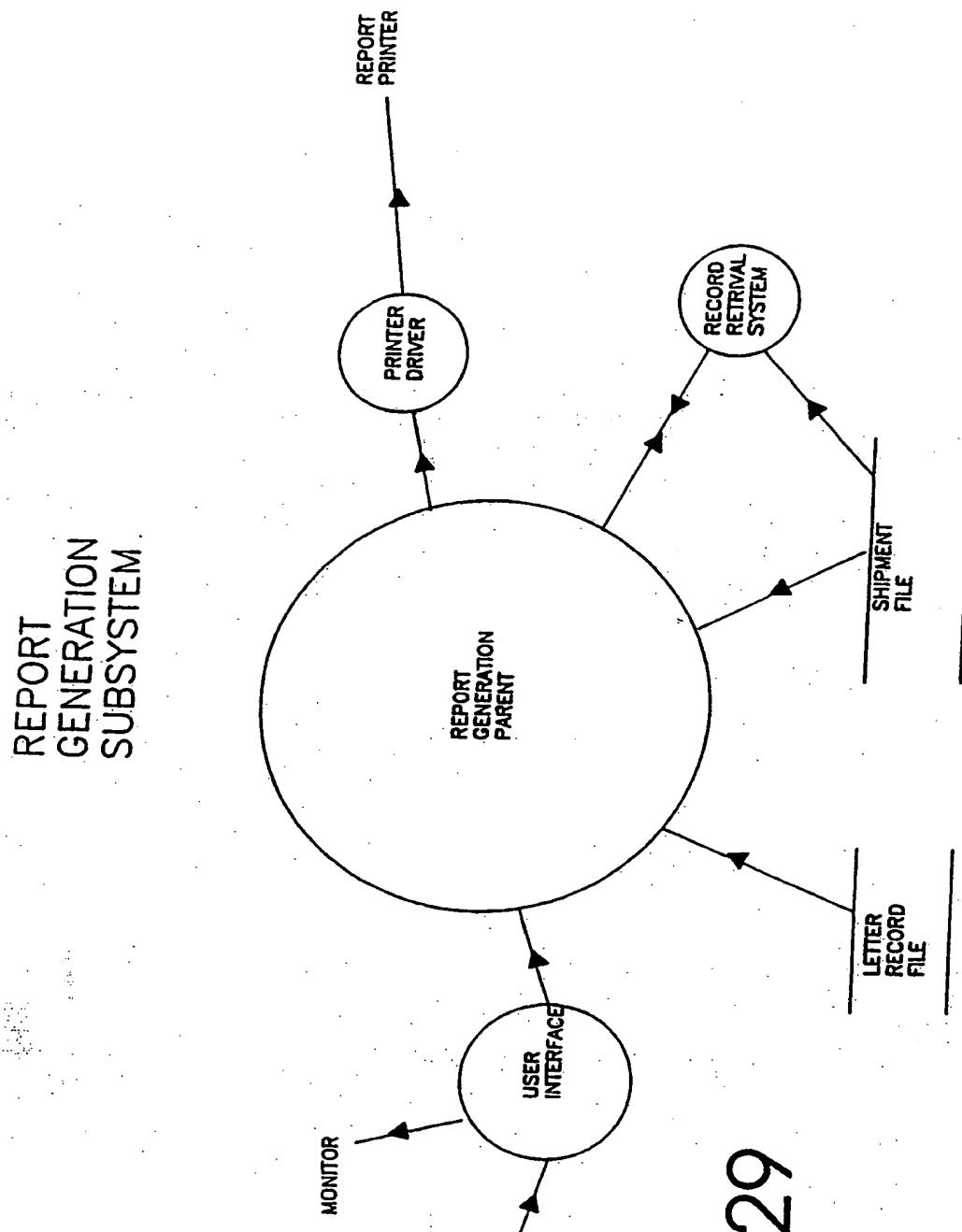
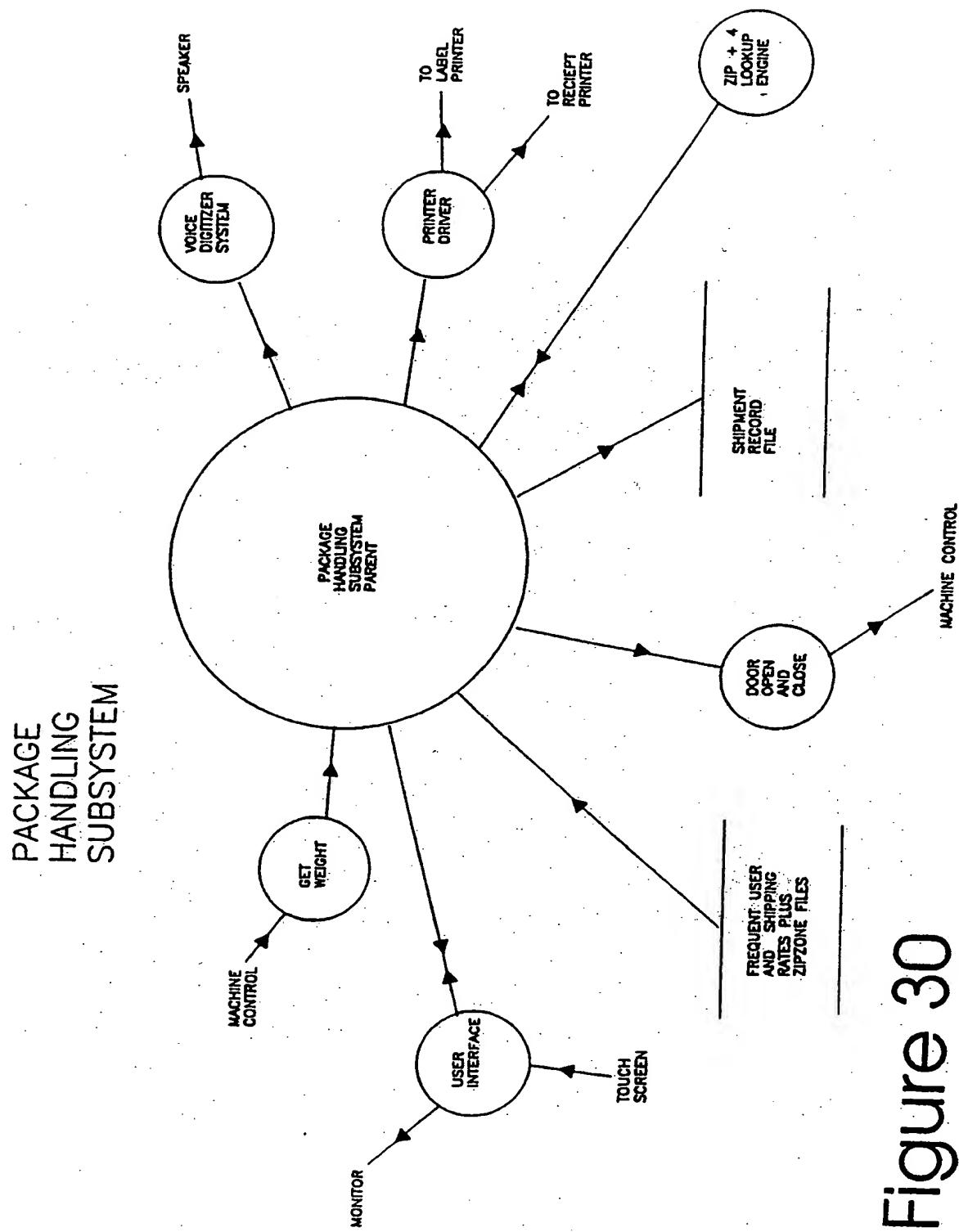


Figure 29

44/45



SUBSTITUTE SHEET

Figure 30

45/45

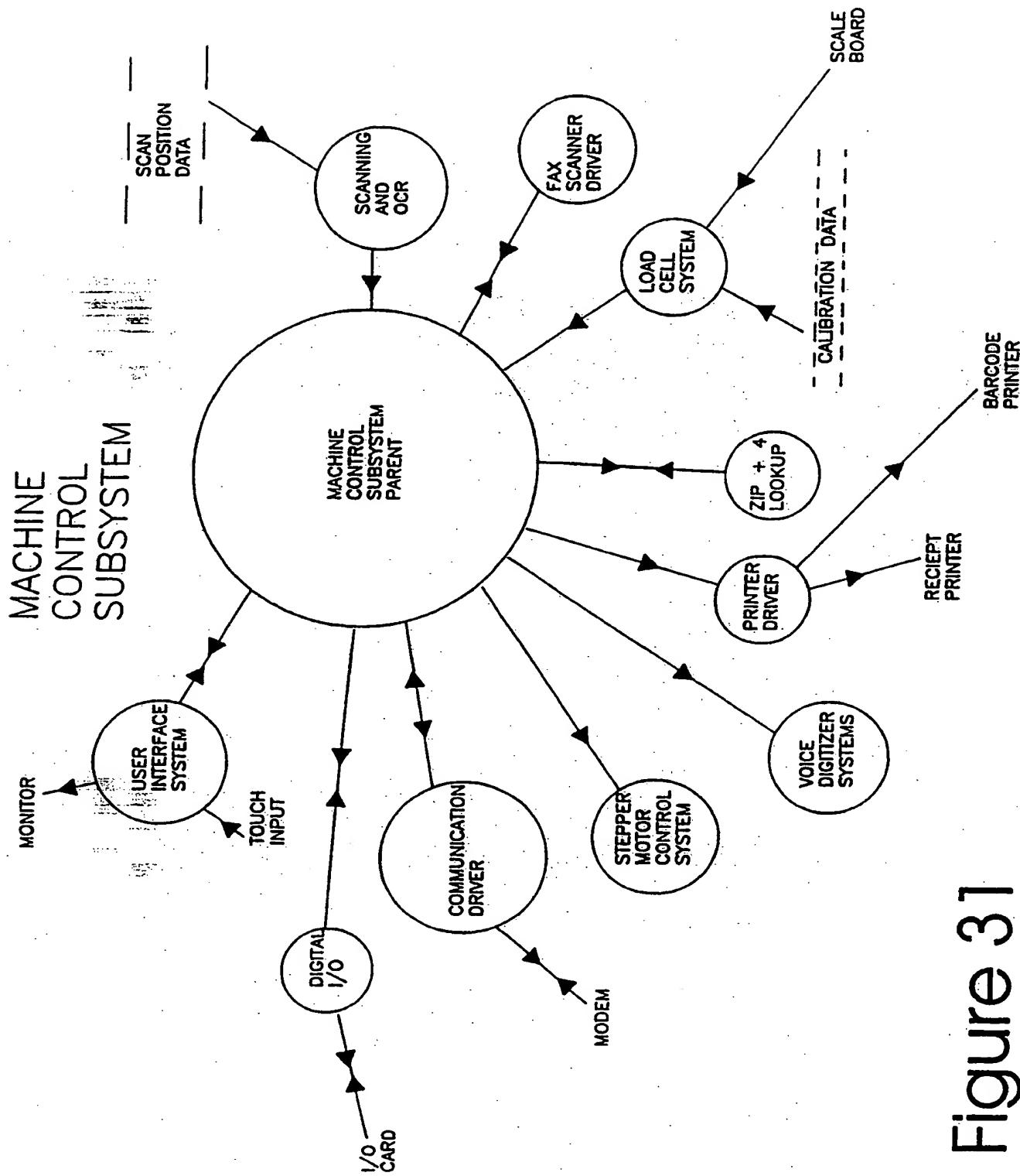


Figure 31

# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US92/02510

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) <sup>6</sup>

A. International Patent Classification (IPC) or to both National Classification and IPC

IPC(5): G07B 17/00

US CL : 364/478

## II. FIELDS SEARCHED

Minimum Documentation Searched <sup>7</sup>

Classification System	Classification Symbols
U.S.	364/478, 464.02; 235/381

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>

## III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup>

Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
Y	US, A, 4,024,380 (GUNN) 17 May 1977, See figure 6c, and columns 1-3.	1
Y	US, A, 4,598,810 (SHORE ET AL.) 08 July 1986, See column 1 objects of the invention.	1
Y	US, A, 4,803,348 (LOHREY ET AL.) 07 February 1989, See claim 26.	1
X	US, A, 4,825,053 (CAILLE) 25 April 1989, See column 4, lines 18-54.	1
X	US, A, 4,900,905 (PUSIC) 13 February 1990, See claims 1, 7, 11 and figure 2.	1
Y	US, A, 4,940,887 (SHENG-JUNG) 10 July 1990, See summary and column 5, lines 16-26.	1
X, P	US, A, 5,025,386 (PUSIC) 18 June 1991, See abstract and claims 1, 7, 12, 15).	1
Y, P	US, A, 5,065,000 (PUSIC) 12 November 1991, See invention summary.	1

\* Special categories of cited documents: <sup>10</sup>

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

## IV. CERTIFICATION

Date of the Act <sup>14</sup> Date of the International Search

Date of Mailing of this International Search Report

22 JUNE 1992

28 JUL 1992

International Searching Authority

ISA/US

Signature of Authorized Officer

*Paul P. Gordon*  
PAUL P. GORDON

THIS PAGE BLANK (USPTO)